SOIL SURVEY OF THE YAMHILL AREA, OREGON

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THE YAMHILL AREA consists of all of Yamhill County, except for the extreme western part that is in the Siuslaw National Forest. It is located on the west side of the lower middle part of the Willamette Valley (fig. 1) and is bounded by Washington, Clackamas, Polk,

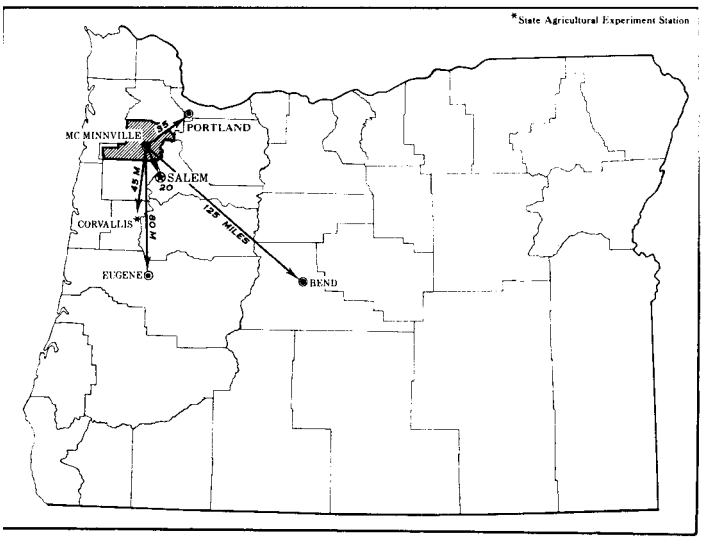

Figure 1.-Location of the Yamhill Area in Oregon.

and Tillamook Counties. The Willamette River is the eastern boundary. The Yamhill Area extends from about 15 miles southwest of Portland to within 11 miles of the Pacific Ocean. McMinnville, the county seat and largest town, is in the east-central part. The total land area is approximately *424,360* acres. About *386,380* acres is privately owned, and most of the remaining *37,980* acres is managed by the U.S. Bureau of Land Management.

The survey area is divided into two general areas: a smooth valley area in the southern and eastern parts that is used for farming, and a hilly or mountainous area in the western and northern parts that is used for timber.

With the exception of a few small streams and the Nestucca River, which originate near the summit of the Coast Range and flow westward to the Pacific Ocean, the drainage of more than 95 percent of the Area is eastward through the forks of the Yamhill River and Chehalem Creek into the Willamette River which flows into the Columbia River at Portland.

In mapping the survey area, two intensities of soil mapping were used. In the forested-hilly or mountainous part of the survey area, soils were examined at moderate to wide intervals and were mapped at medium intensity. In the smooth Willamette Valley part, the soils were examined at close intervals and were mapped at high intensity, or in considerably more detail than in the forested-hilly or mountainous part. Most of the soils mapped at high intensity have a narrow range of slope. They are in the southern and eastern parts of the survey area, and the soils mapped at medium intensity are in the western and northern parts.

To show which soils were mapped at medium intensity and which at high intensity, the kind of map symbol assigned to the soils mapped at medium intensity was made to differ slightly from the one assigned to the soils mapped at high intensity. The second letter of the map symbol is a capital letter if the mapping unit is one of those mapped at medium intensity, for example, ASE. It is a small letter if the mapping unit is one of those mapped it high intensity, for example, CaB. A list of all the soils in the survey area, their map symbol, and the capability unit, woodland group, and wildlife group to which each has been assigned can be found in the "Guide to Mapping Units" at the back of this publication.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in the Yamhill Area, where they are located, and how they can be used. The soil scientists went into the Area knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase*

are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Chehalis and Jory, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Jory clay loam, 2 to 7 percent slopes, is one of several phases within the Jory series.

After a guide for classifying and naming the soils had been worked out, the, soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the, aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it, is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. One such kind of mapping unit, called an undifferentiated group, is shown on the soil map of the Yamhill Area.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Kilchis and Klickitat soils, 60 to 90 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Shale rock land is a land type in the Yamhill Area.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge, of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the Yamhill Area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in the Yamhill Area are each discussed in the following pages. The terms for texture used in the descriptive title for several of the associations apply to the surface layer. For example, in the descriptive title for association 1, the words "silty clay loams, silt loams, and fine sandy loams" refer to texture of the surface layer.

Areas Dominated by Somewhat Excessively Drained to Poorly Drained, Nearly Level and Gently Sloping Soils on Bottom Lands

Soils of these areas are dominantly on bottom lands, but some are on fans and lake bottoms. Most of the soils are either well drained or poorly drained. Elevations range from about 100 to 300 feet. Annual precipitation is 40 to 60 inches.

Many of the soils are subject to flooding. Some have a seasonal high water table. Most of the soils are farmed, some to a wide variety of crops.

1. ***Chehalis-Cloquato-Newberg association***

Well-drained and somewhat excessively drained silty clay loams, silt loams, and fine sandy looms

This association is on recent alluvial bottom lands and flood plains along the larger streams. It has a nearly level to gently undulating topography and in places is traversed by meandering overflow channels. In areas that are not cultivated, the vegetation is ash, cottonwood, and willow. Elevation ranges from 30 to 300 feet. Annual precipitation is 40 to 60 inches. Winters are cool and moist, and summers are warm and dry. The average annual air temperature is 53° F., and the growing season is 165 to 210 days.

This association occupies about 4 percent of the Yamhill Area. About 32 percent of the association is made up of Chehalis soils, Cloquato soils make up 30 percent, and Newberg soils 20 percent. The remaining 18 percent is made up of McBee and Wapato soils.

The soils in this association formed in bands parallel to the stream. Newberg soils are along the banks of the Willamette River. Cloquato soils are adjacent to the Newberg soils along the Willamette River and along the banks of the other major streams. Chehalis soils are adjacent to the Cloquato soils in slightly higher positions. McBee and Wapato soils are in a few low areas.

Chehalis and Cloquato soils are well drained, and Newberg soils are somewhat excessively drained. The Chehalis soil is dark-brown silty clay loam to a depth of at least 40 inches. In the Cloquato soil the surface layer and upper part of the subsoil are dark-brown silt loam overlying dark yellowish-brown silt loam in the lower part of the subsoil and substratum. Newberg soils have a very dark grayish-brown fine sandy loam or silt loam surface layer and a dark-brown sandy loam subsoil overlying very dark grayish-brown and dark-brown loamy fine sand.

These soils are intensively farmed and are well suited to crops. Because most of these soils are subject to occasional to frequent flooding in winter, fall-planted crops and, in places, berries may be damaged. Some of the soils are at high enough elevation that they are not flooded frequently, and these soils call be used for all crops adapted to the Area. This association is well supplied with irrigation water from shallow wells and streams. Vegetables, fruits, and berries are the major farm crops. The cultivated crops are rotated with legumes and small grain. A cover crop commonly is grown in winter.

Farms are family-type and range in size from 20 to 150 acres. An average farm has 40 acres. The largest acreages are owned by a farm corporation.

Winter flooding is the major hazard on these soils, although flood-control projects in the Willamette River Watershed have reduced this hazard. Low dikes divert the floodwater around this area and allow it to enter at a nonerosive rate.

The soils subject to overflow are poorly suited to use as building sites. They are fairly well suited to year-round use for recreation and are well suited to use for recreation in summer. This association has good food and habitat for birds and animals.

2. ***Wapato-Cove association***

Poorly drained silty clay loams and clays

This association is on recent alluvial bottom lands, flood plains and falls. It occupies small areas along the larger streams and is the major association along the small streams. It has a gently sloping to basinlike topography and is traversed in places by meandering overflow channels. In areas that are not cultivated, the vegetation is ash and willow trees, sedges, and grass. Elevation ranges from 30 to 300 feet. Annual precipitation is 10 to 60 inches. Winters are cool and moist, and summers are warm and dry. The average annual temperature is 53° F., and the growing season is 165 to 210 days.

This association occupies 6 percent of the survey area. Wapato soils make up about 40 percent of the association, and Cove soils about 33 percent. Chehalem, Chehalis, Grande Ronde, Knappa, Labish, and McBee soils make up most of the remaining 27 percent.

Wapato and Cove soils are poorly drained. The Wapato soils are subject to flooding. The surface layer and upper part of the subsoil are mottled very dark grayish-brown silty clay loam, and the lower part of the subsoil is grayish-brown silty clay. Cove soils, which are along smaller streams, have a very dark gray silty clay loam or clay surface layer and a mottled very dark gray clay subsoil.

Because these soils are wet most of the year, they are used mainly for hay and pasture; small grain is grown on the better drained areas. Some soils are improved by tile drainage, and surface ditches remove excess water if adequate outlets are available. Dairy, beef, and sheep enterprises are common in this association.

Farms are generally family-type and range in size from 20 to 300 acres. The average farm is 100 acres.

Ponding of water in winter is the major hazard in this association. A high water table persists until late in spring. Open drains and improved channels remove much of the excess water. Low dikes divert the water around the area so that it enters at a nonerosive rate.

This association is poorly suited to building sites and recreational use. It is suited to waterfowl habitat.

Areas Dominated by Well-Drained to Poorly Drained, Nearly Level to Moderately Steep Soils on Terraces

Soils of these areas are on the terrace plain that forms the Willamette Valley floor. These soils are between the alluvial soils of the bottom lands and the low foothills of the Coast Range. On these terraces there are large areas of well drained and moderately well drained soils and smaller areas of somewhat poorly drained and poorly drained soils. Elevations range from 150 to 400 feet. Annual precipitation is 40 to 50 inches.

The well drained and moderately well drained soils are farmed to a wide variety of crops. The somewhat poorly drained and poorly drained soils are farmed to a more limited variety of crops.

3. Woodburn- Willamette association

Moderately well drained and well drained, nearly level to moderately steep silt loams and silt loams over silty clay loam

This association is on the broad, nearly level terrace plain that forms the floor of the Willamette Valley. In areas that are not cultivated the vegetation is oak and Douglas-fir trees and grasses. Elevation ranges from 150 to 400 feet. Annual precipitation is 40 to 50 inches. Winters are cool and moist, and summers are warm and dry. The average annual air temperature is 53° F., and the growing season is 165 to 210 days.

This association occupies 16 percent of the survey area. Woodburn soils make up 56 percent of the association, Willamette soils 9 percent, and Carlton soils 8 percent. Amity, Aloha, Dayton, and Briedwell soils make up the remaining 27 percent.

Woodburn soils are well drained. They have a surface layer of very dark grayish-brown silt loam and a subsoil of dark yellowish-brown and dark grayish-brown heavy silt loam that is mottled in the lower part. Willamette soils are we drained and are in the narrow points between the junctions drainageways and on the gently undulating plain in the vicinity Bellevue. They are very deep and friable, and they have dark-brown silt loam surface layer and a dark-brown silty cla loam subsoil.

These soils are intensively farmed and are well suited to crop All crops adapted to the Area are grown. On most farms, sma grain is grown in rotation with grass and legume seed, hay, ar pasture. Orchard trees and dryland berries are grown in places. I the 20 percent of the association that has irrigation water fro either deep wells or streams, dairying and growing of berries ar vegetable crops (fig. 2) are the major farm enterprises. Some farn have a secondary beef or sheep enterprise. There are fe Douglas-fir woodlots, but they are gradually being cleared f other crops.

Farms range from 5 to more than 1,000 acres in size and a average farm has 160 acres. Most of the farms of less than 16 acres are worked part time or are rented to

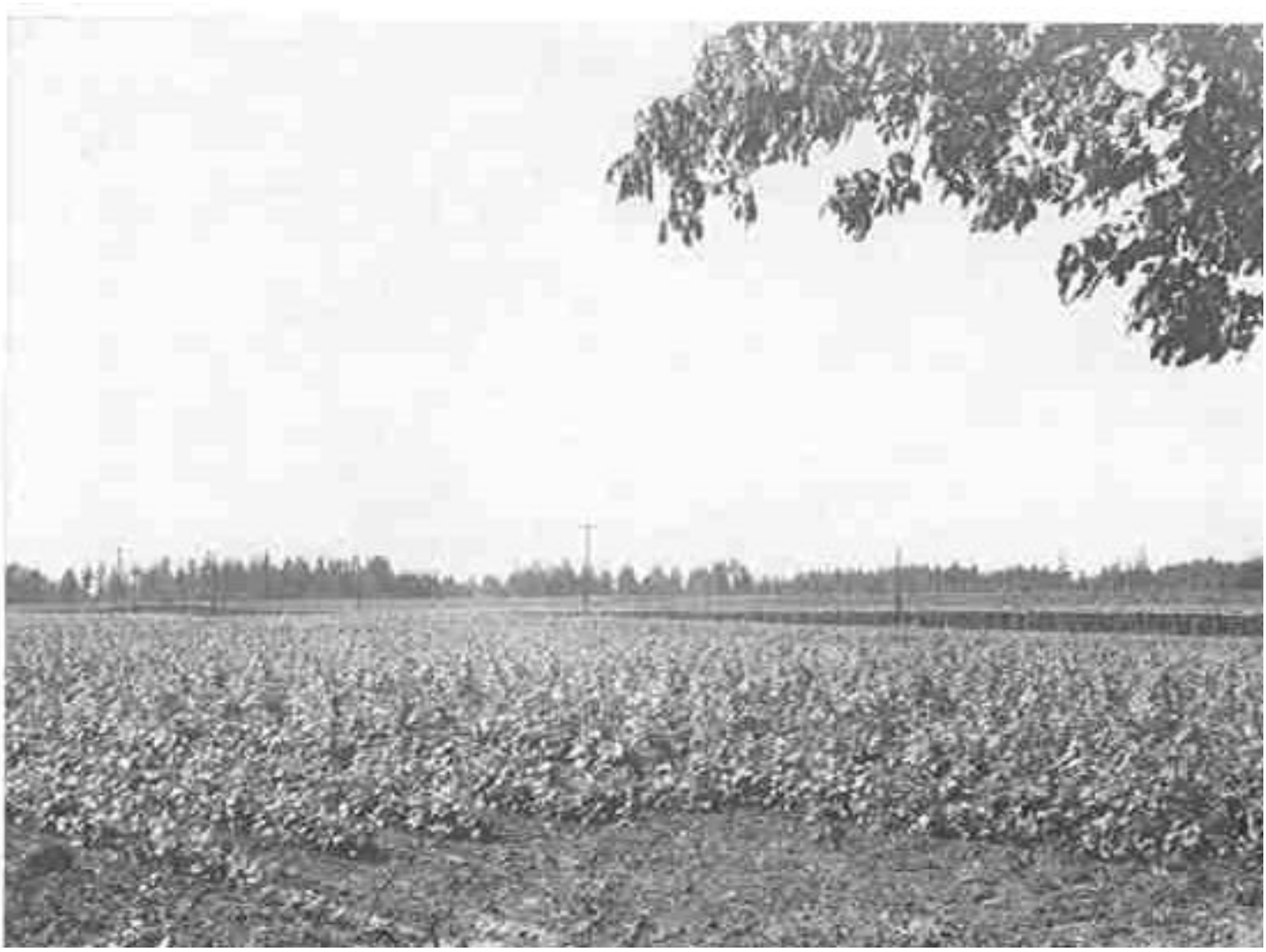

Figure 2.-Irrigated bush beans and pole beans on Willamette and Woodburn soils of association 3. Douglas-fir trees in the back ground are on areas of Terrace escarpments along one of the streams that meanders through this soil association.

larger landowners for either cash or crop rent. One large corporate farm is in this association. The other farms are family-type.

Erosion is not a serious hazard in most of the association. in places slight to severe erosion occurs on the gently to strongly sloping sides of drainageways. The moderately well drained Woodburn soils require a random system of tile drains to grow deep-rooted crops such as alfalfa and strawberries.

This association has very good sites for town and country development, and for recreation developments. It has food and habitat for many kinds of game birds and animals.

4. Amity-Dayton association

Somewhat poorly drained and poorly drained, nearly level silt loams over silty clay loam and clay

This association is on the broad, nearly level terrace plain that forms the floor of the Willamette Valley (fig. 3). It is in the level areas that lead into shallow drainageways and at the foot of low, rolling hills. Extensive areas are near Hopewell and on the Dayton prairie. In areas that are not cultivated, the vegetation is grasses, sedges, rosebush, and widely spaced oak and ash trees. Elevation ranges from 150 to 200 feet. Annual precipitation is 40 to 45 inches. Winters are cool and moist, and summers are warm and dry. Average annual air temperature is 52° to 54° F., and the growing season is 165 to 210 days.

This association occupies 3 percent of the survey area. Amity soils make up about 60 percent of the association, and Dayton soils about 30 percent. The remaining 10 percent is less extensive soils, mainly of the Willamette, Woodburn, and Aloha series.

Amity soils are very deep and somewhat poorly drained. They have a surface layer of very dark grayish-brown silt loam and a subsoil of mottled grayish-brown silty clay loam. Dayton soils are shallow to moderately deep and poorly drained. They have a surface layer of grayish-brown silt loam and a subsoil of dark grayish-brown clay. These soils have a distinctive surface color that makes them easy to recognize. The Amity soils are known locally as "half -white land" and Dayton soils as "white land."

Because these soils are wet during winter, they are used mainly to grow small grain, hay, pasture plants, grass, and legume seed. If drained, the Amity soils can be used for vegetables and improved pasture and hay. They respond well to deep tile drains. The poorly drained Dayton soils still have limited use after drainage because the claypan is at shallow depth. In some areas, pasture and vegetable crops are irrigated from deep wells. Dairy, beef, and sheep enterprises are common in this association.

Farms range from 10 to 600 acres in size, and an average farm has 150 acres. Most of the smaller farms are worked part time or are rented to larger landowners for either cash or crop rent. The other farms are family-type.

Erosion is not a problem in this association. A high water table during winter and spring seriously affects land use. Random or grid tile drainage is very effective on the somewhat poorly drained Amity soils. Tile drainage on the poorly drained Dayton soils has generally been restricted to areas where they are intermingled with other soils. Because large areas of Dayton soils lack adequate outlets for tile, surface drainage by shallow ditches and bedding is common.

This association has fair to poor sites for buildings, and recreational use is limited during winter. Some areas have food and habitat for game animals and birds.

Areas Dominated by Well-Drained to Somewhat Poorly Drained, Gently Sloping to Very Steep Soils on Low Foothills of the Oregon Coast Range

Soils of these areas occur as isoilated hills and as foothills of the Coast Range. Most of the soils are well drained. Slopes are 2 to 90 percent. Elevations range from 250 to 1,200 feet. Annual precipitation is 40 to 70 inches.

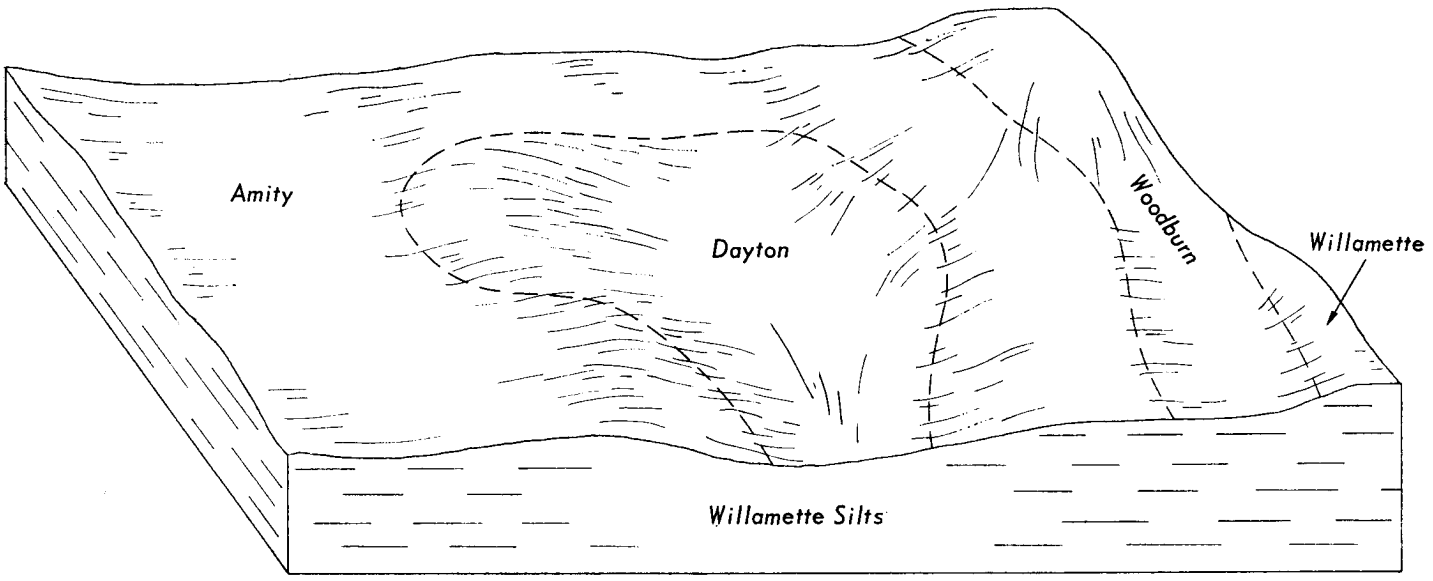

Figure 3.-Pattern of typical soils of association 4 on recent alluvial bottom lands, flood plains, and terraces of the Willamette Valley.

Erosion is a major hazard in many of the areas. Soil use ranges from intensive farming to tree farming. Douglas-fir and oak are the dominant trees.

5. Laurelwood association

Well-drained, gently sloping to steep silt loams over silty clay loam; formed in mixed material

This association is on the uplands. Slopes range from 3 to 60 percent. In areas that are not cultivated, the vegetation is Douglas-fir, bigleaf maple, and Oregon-grape. Elevations range from 300 to 1,200 feet. Annual precipitation is 45 to 50 inches. The average annual temperature is 51° F., and the growing season is 165 to 210 days.

This association occupies 2 percent of the survey area. Laurelwood soils make up 90 percent of the association. The remaining 10 percent is mainly Jory and Nekia soils.

Laurelwood soils are very deep. They have a dark-brown silt loam surface layer over a thick, dark-brown silty clay loam subsoil. Small areas of reddish-brown Jory and Nekia soils are present where basalt bedrock is less than 6 feet below the surface.

These soils are intensively farmed and are well suited to crops. On most farms, small grains are grown in rotation with grass and legume hay and pasture. There are walnut and other orchards, and some areas are used for dryland strawberries. Beef and sheep enterprises are common. Many farms have, Douglas-fir woodlots, and part of this association is in corporate tree farms.

Farms range from 100 to more, than 1,000 acres in size and an average farm has 160 acres. Most farms are family-type.

Where slopes are less than 12 percent, this association has very good sites for buildings and recreational use. The steeper slopes are more limiting, but offer a scenic view. The soils are used for limited water supply and furnish good habitat and food for game birds and animals.

6. Jory-Yamhill-Nekia association

Well-drained, gently sloping to very steep, clay loams over clay and silt loams over silty clay; formed in basaltic colluvium

This association is on the Eola, Amity, and Dundee Hills, the southern slopes of Chehalem, Mountain, and the foot slopes of the Coast Range from Yamhill to Sheridan. The topography is smooth and gently sloping to very steep. In areas that are not cultivated, the vegetation is Douglas-fir and oak trees, poison-oak, and grass. Elevations range from 250 to 1,200 feet. Annual precipitation is 40 to 60 inches. Winters are cool and moist, and summers are warm and dry. Average annual air temperature is 52° to 54° F., and the growing season is 165 to 210 days.

This association occupies 11 percent of the survey area. Jory soils make up 65 percent of the association, Yamhill soils 20 percent, and Nekia soils 10 percent. The remaining 5 percent is less extensive soils, mainly of the Willakenzie series.

This association consists of the well-drained "red hill soils" that formed from basalt. The Jory soils have a dark reddish-brown clay loam surface layer and a dark reddish-brown silty clay or clay subsoil. They are more than 40 inches deep to basalt. Nekia soils are similar except they are 20 to 40 inches deep to basalt. Yamhill soils formed on the lower slopes adjacent to the Willamette Valley floor. They have a dark-brown silt loam surface layer and a dark reddish-brown silty clay subsoil. Depth to basalt ranges from 20 to 40 inches.

These soils are intensively farmed. On most farms, small grains are grown in rotation with grass and legume hay and pasture. There are extensive walnut, cherry, and prune orchards, and some dryland strawberries. Beef and sheep enterprises are common. Many farms have Douglas-fir and oak woodlots (fig. 4).

Farms range from 50 acres to 900 acres in size, and an average farm has 200 acres. Most of these are family-type farms.

Erosion is a severe hazard in this area. The long, smooth slopes have sufficient grade so that the friable topsoil erodes during heavy rains. In many places, moderate depth to hard bedrock limits root penetration.

On slopes of less than 12 percent, this association has very good sites for buildings and recreational developments. The steeper slopes are more limiting, but offer a scenic view. The soils are used for limited water supply and furnish good habitat and food for game birds and animals.

7. Willakenzie-Hazelair association

Well-drained and somewhat poorly drained, gently sloping to steep silty clay loams and silty clay loams over clay; formed over sedimentary rock

This association is on the Eola, Amity and Dundee Hills, Ribbon Ridge, and the foot slopes of the Coast Range from Yamhill to Sheridan. The topography is smooth and gently sloping to steep (figs. 5 and 6). In areas that are not cultivated, the vegetation is oak trees, poison-oak, grass, and widely spaced Douglas-fir trees. Elevations range from 250 to 800 feet. Annual precipitation is 40 to 60 inches. Winters are cool and moist, and summers are warm and dry. The average annual air temperature is 52° to 54° F., and the growing season is 165 to 210 days.

This association occupies 12 percent of the survey area. Willakenzie soils make up 75 percent of the association, Hazelair soils 10 percent, and the remaining 15 percent is less extensive soils of the Dupee, Panther, and Steiwer series.

The Willakenzie soils have a dark-brown silty clay loam surface layer and subsoil. Hazelair soils are somewhat poorly drained. They have a surface layer of dark-brown silty clay loam, a subsoil of mottled dark-brown silty clay, and a light olive-brown clay substratum overlying siltstone or sandstone.

These soils are not intensively farmed. On most farms, small grains are grown in rotation with grass and legume hay and pasture. There are scattered walnut, filbert, and prune orchards. Beef and sheep enterprises are common in this association. There are extensive areas of oakgrass pasture, and a few Douglas-fir tree farms.

Farms range from 40 to 1,000 acres in size and average about 250 acres. Most farms are family-type.

Figure 4-Mixed oak and Douglas-fir on Jory, Yamhill, and Nekia soils of association 6. Hazelair soils are in the foreground.

Erosion is a severe hazard in this association. The smooth slopes have sufficient grade and the surface layer is unstable, so that erosion is common during heavy winter and spring rains. These soils have moderate fertility, and organic-matter content is generally low. In many places, moderate depth to soft bedrock restricts root penetration.

This association has fair sites for buildings and recreational developments. It offers a scenic view, but there are many slumps and trafficability is poor during wet weather. These soils are used for limited water supply, and they have good habitat and food for game animals and birds.

8. Peavine association

Well-drained, gently sloping to steep, silty clay loams oversilty clay; formed over sedimentary rock

This association is on a long bend of foothills from Mt. Richmond to Grand Ronde. It is gently sloping to steep. The gentle slopes are smooth, and the steeper slopes are commonly hummocky and uneven as a result of soil slides and slumps. In areas that are not cultivated, the vegetation is Douglas-fir, bigleaf maple, oak trees, and poison-oak. Elevations are 400 to 1,200 feet. Annual precipitation is 55 to 70 inches. Winters are cool and moist to wet, and summers are warm and dry. Average annual air temperature is 51° F., and the growing season is 165 to 210 days.

This association occupies 14 percent of the Yamhill Area. Peavine soils occupy 80 percent of the association, and Panther soils 5 percent. The remaining 15 percent is less extensive soils, including Willakenzie soils and Hazelair and Steiwer soils, acid variants.

This association consists of soils that formed from siltstone and shale. Peavine soils are well drained and have a surface layer of very dark brown silty clay loam and a subsoil of yellowish-red silty clay.

These soils are not intensively farmed. Large areas are in Douglas-fir tree farms and oak and Douglas-fir woodlots. Small grain is grown in rotation with grass and

Figure 5-Typical landscape in association 7. Willakenzie soils are on the hills in the background, Hazelair soils occupy the low area in the foreground, and Steiwer soils are on the grassy side slopes at the right. The Hazelair soils are protected from runoff by diversion ditches.

legume hay and pasture. Beef and sheep enterprises are common. A few scattered areas are used for walnut and prune trees.

Farms range from 40 to several thousand acres in size. Most farms are family-type. There are several large corporate tree farms.

Erosion is a severe hazard in this association. The slopes have sufficient grade and the surface layer is unstable, so erosion is common during heavy rains in winter and spring. Shallow slides and slumps occur during periods of heavy rainfall. Fertility is moderate, and organic-matter content is generally low. In some places, moderate depth to soft bedrock restricts root penetration.

This association has fair sites for buildings and recreational developments. It offers a scenic view, but there are many slumps and trafficability is poor during wet weather. The soils are used for limited water supply and have good habitat for game animals and birds.

Areas Dominated by Well-Drained, Gently Sloping to Very Steep Soils on the Oregon Coast Range

The well-drained soils of the Coast Range are in the rugged, western part of the Yamhill Area. The areas are mainly ridges and long steep slopes dissected by numerous streams. Elevations are 500 to 3,000 feet. Annual precipitation is 60 to 120 inches.

Erosion is a severe hazard on these soils. Tree farming is the major enterprise, and Douglas-fir is the principal tree grown. Because of the heavy precipitation, the areas are a major source of water supply.

9. Olyic association

Strongly acid silt loams over silty clay loam; 60 to 80 inches annual precipitation

This association occupies a long wide band along the lower Coast Range from Washington County to Polk

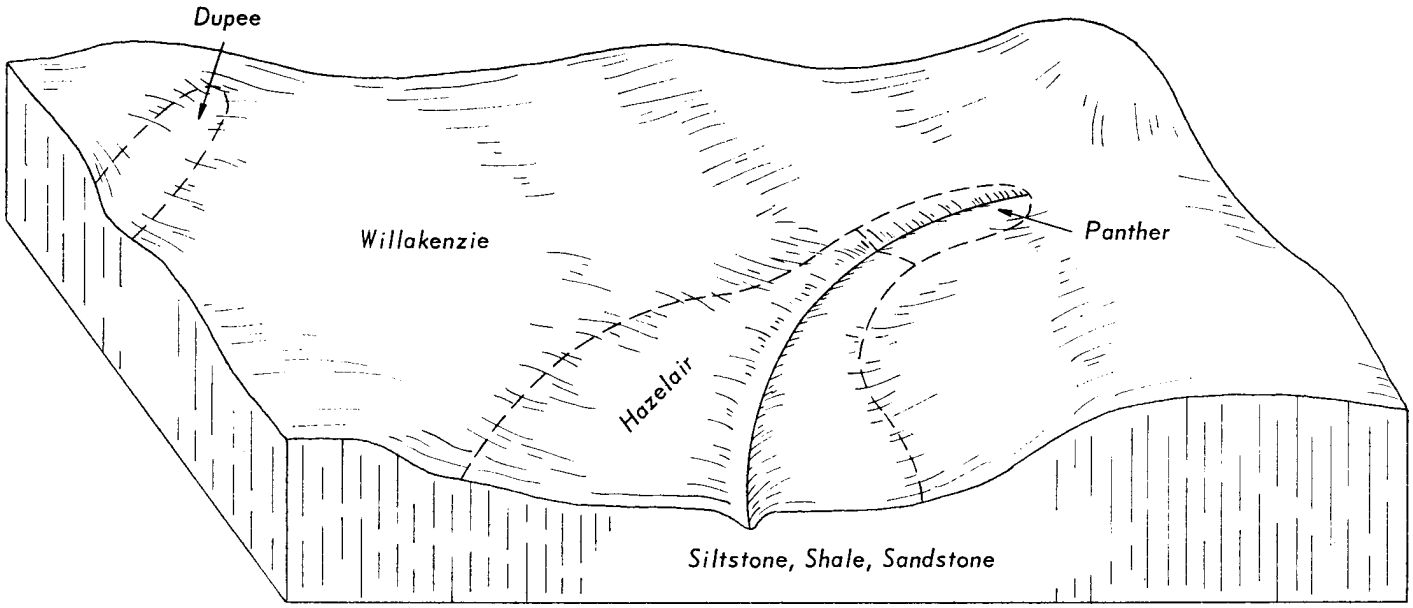

Figure 6-Pattern of soils of association 7 on terraces and low foothills of the Coast Range.

County. It has gentle to very steep slopes and gently sloping to moderately sloping ridgetops. In areas that are not cultivated, the vegetation is Douglas-fir, alder, bigleaf maple, vine maple, and swordfern. Elevations are 500 to 2,000 feet. Annual precipitation is 60 to 80 inches. Winters are cool and wet, and summers are warm and dry. Average annual air temperature is 49° F., and the growing season is 145 to 200 days.

This association occupies 12 percent of the survey area. Olyic soils make up 70 percent of the association, Ead soils 13 percent, and Melby soils 7 percent. The remaining 10 percent is Peavine soils and other less extensive soils and land types.

This association is composed of soils that formed from either basalt or siltstone and shale. The soils are well drained and generally deep to rock. Olyic soils have a surface layer of dark reddish-brown silt loam and a subsoil of dark reddish-brown silty clay loam over basalt. Some areas are stony.

This association is used primarily for Douglas-fir production. In some places alder is cut for pulpwood, and swordfern and salal are harvested for the florist trade. Some areas of pasture are in this association, and beef cattle graze on cutover areas.

The tree farms in this association are large and are owned by either the U. S. Government or large corporations. There are a few large privately owned farms and some municipal watersheds.

Erosion is a severe hazard in this association. The slopes have sufficient grade to be erodible when disturbed by equipment, especially during winter.

This association has good sites for building and most recreational developments. Some areas have slumps during wet months. The soils are a major source of water supply and have good habitat for game animals and some birds.

10. ***Hembre-Astoria-Klickitat association***

Very strongly acid silt loams over silty clay loam and silty clay, and stony loams over very gravelly clay loam; 80 to 120 inches annual precipitation

This association is on the high Coast Range along the western boundary of the survey area (fig. 7). It has gentle to very steep slopes and gently sloping to moderately sloping ridgetops. The vegetation is Douglas-fir, hemlock, alder, vine maple, and swordfern. Elevations are 500 to 3,000 feet. Annual precipitation is 80 to 120 inches. Winters are cool and wet, and summers are cool and dry. Average annual temperature is 49° F., and the growing season is 145 to 200 days.

This association occupies 20 percent of the survey area. Hembre soils make up 56 percent of the association, Astoria soils 27 percent, and Klickitat soils 14 percent. The remaining 3 percent of the association is Kilchis soils and Stony land.

This association is composed of soils that formed from either basalt or siltstone and shale. The soils are well drained and generally deep to rock. Hembre soils have a surface layer of dark reddish-brown silt loam and a subsoil of reddish-brown silty clay loam over basalt rock. Astoria soils have a surface layer of very dark brown silt loam and a subsoil of strong-brown silty clay over siltstone and shale. Klickitat soils have a surface layer of dark reddish-brown stony loam and a subsoil of dark reddish-brown stony clay loam over basalt. Small areas of shallow very stony Kilchis soils are on very steep slopes.

This association is used primarily for Douglas-fir production (fig. 8). In some places alder is cut for pulpwood, and swordfern and salal are harvested for the florist trade. Beef cattle graze on cutover areas.

The tree farms in this association are large and are owned by either the U. S. Government or large corporations.

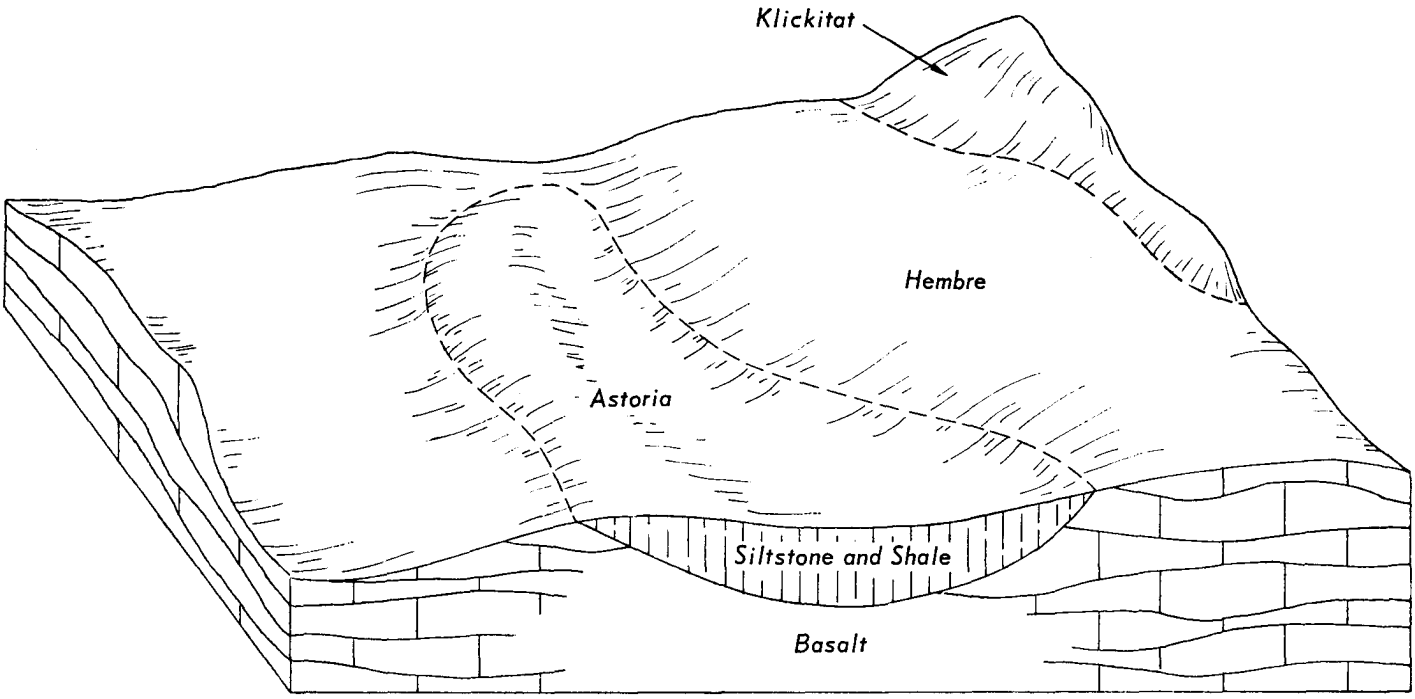

Figure 7-Pattern of typical soils of association 10 that are on the Coast Range.

Erosion is a severe hazard in this association. The slopes have sufficient grade to be erodible when disturbed by equipment, especially during winter.

This association has good to poor sites for buildings and most recreational uses. Some areas have slumps during wet months. As a result of the heavy precipitation, these soils are a major source of water supply through seep, percolation, and runoff. These soils have good habitat and food for game animals and some birds.

Descriptions of the Soils

This section describes the soil series and mapping units of the Yamhill Area. The approximate acreage and proportionate extent of each mapping, unit are given in table 1.

The procedure in this section is first to describe the soil series, and then the mapping units in that series. For each soil series, a profile of a soil representative of the series is briefly described. Thus, to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. Unless otherwise stated, the colors given in the descriptions are for the soils when moist. As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Stony land, for example, does not belong to a soil series, but, nevertheless, it is listed in alphabetic order along with the soil series.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, woodland group, and wildlife group in which the mapping -unit has been placed. The pages on which the capability units and woodland groups are described can be found by referring to the "Guide to Mapping Units" at the back of this survey.

Terms related to soil science that are used in the soil descriptions and in other parts of the survey are defined in the Soil Survey Manual (*19*).1 Many of these terms are also defined in the Glossary.

Alluvial Land

Alluvial land (AL) occupies long, narrow areas on stream bottoms. It is also on local fans that extend from side draws that have cut into areas underlain by mixed igneous and sedimentary rocks. This land type is nearly level and gently undulating. It consists of recent accumulations of sediment derived from many different rocks and from soils of the uplands. Sonic of the sediment has been carried a considerable distance by streams, sorted to some extent according to size of particles, and redeposited along the course of the stream. The areas adjacent to major drainageways receive new sediment when flooding occurs during periods of heavy rainfall and rapid snowmelt. The vegetation is dominantly alder, with some Douglas-fir, spruce, and cedar.

This land type is well drained, and a weakly structured subsoil has developed in places. The surface layer is dark-brown sandy loam to black loam and silt loam. The material below the surface layer is yellowish-brown gravelly loam to strong-brown silty clay loam. The soil material is strongly acid throughout.

' Italic numbers in parentheses refer to Literature Cited, p. 128.

Figure 8~Typical landscape in association 10. The patch system of logging used in this area provides an adequate source of seed for reforestation and the sunlight required by Douglas-fir seedlings.

Included with this land type in mapping are small areas of Fresh water marsh.

Alluvial land is well suited to alder. It is easily managed. Little erosion of the surface layer takes place, but some caving of streambanks occurs, and occasionally some raw soil material is deposited on the surface. The wider areas are well suited to use for landings and access roads. Capability unit VIe-2; not placed in a woodland group; wildlife group 5.

Aloha Series

The Aloha series consists of somewhat poorly drained soils that formed in old alluvium on the Willamette Valley terraces. Slopes are 0 to 3 percent. Elevations range from 150 to 200 feet. The average annual precipitation is 40 to 50 inches. The average annual air temperature is 53° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is grass, Oregon white oak, and Douglas-fir. Aloha soils are associated with Willamette, Woodburn, and Amity soils.

In a representative profile, the surface layer is dark-brown silt loam about 7 inches thick. The subsoil is distinctly mottled dark-brown, slightly brittle heavy silt loam about 26 inches thick. It is underlain by brown, firm silt loam that extends to a depth of more than 60 inches.

Aloha soils are used for vegetable and berry crops, orchards, small grain, hay, and pasture. They are also used for recreation, wildlife habitat, and homesites.

Aloha silt loam (0 to 3 percent slopes) (Ah).-This soil is most extensive in the Dayton and Newberg communities.

In the original manuscript, there was a table in this space.
All tables have been updated and are available as a separate document.

Representative profile in the Dayton area, about 150 feet north of the county road and 150 feet west of driveway; NW1/4NE1/4 sec. 15, T. 4 S., R. 3 W.:

Ap-0 to 7 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; friable, slightly hard, slightly sticky, slightly plastic; many very fine pores; many fine roots; medium acid (pH 5.8) ; abrupt, smooth boundary. (6 to 9 inches thick)

B1-7 to 13 inches, dark-brown (10YR 4/3) heavy silt loam, light yellowish brown (10YR 6/4) when dry; many, fine, distinct, dark reddish-brown and dark-brown mottles; moderate, fine, subangular blocky structure; friable, hard, sticky, slightly plastic; thin patchy films on some ped surfaces; many very fine pores; many fine roots; medium acid (pH 5.8) ; clear, smooth boundary. (5 to 9 inches thick)

B21-13 to 23 inches, dark-brown (10YR 4/3) heavy silt loam, pale brown (10YR 6/3) when dry; many, fine, distinct, yellowish-brown and reddish-brown mottles; moderate, fine, subangular blocky structure; firm, hard, sticky, slightly plastic; many very fine pores, and common fine and medium pores; common fine

roots; few black stains; few, thin, patchy films on some ped surfaces; medium acid (pH 5.8) ; clear, smooth boundary. (5 to 10 inches thick)

B22-23 to 33 inches, dark-brown (10YR 4/3) heavy silt loam, pale brown (10YR 6/3) when dry; many, fine, distinct, yellowish-brown and reddish-brown mottles; weak, medium and coarse, subangular blocky structure; firm, hard, slightly brittle, slightly sticky, slightly plastic; few roots; common fine and medium pores; few, thin, patchy films on some ped surfaces; many, fine, black stains; medium acid (pH 5.8) clear, smooth boundary. (6 to 13 inches thick)

C3-33 to 60 inches, brown (10YR 5/3) silt loam, pale brown (10YR 6/3) when dry; many, dark-brown and yellowish-brown mottles; massive; firm, hard, slightly brittle, slightly sticky, slightly plastic; very few roots; common fine and medium pores; few, fine, black stains; light-gray streaks along the larger channels; medium acid (pH 6.0).

When moist, the A horizon has chromas of 2 and 3. When dry, it has values of 5 or 6. The B horizon has faint to distinct mottles throughout. The matrix has moist values of 4 and 5 and chromas of 3 and 4.

Included with this soil in mapping are some areas of Amity, Willamette, and Woodburn soils. These areas are less than an acre in size and occupy less than 5 percent of the total acreage of this mapping unit.

This soil has moderately slow permeability. Roots can penetrate to a depth of more than 60 inches. The available water capacity is 11 to 13 inches. Tilth is good, but cultivation may be restricted by a high water table during winter and early in spring. Surface runoff is slow and some areas are slightly susceptible to sheet erosion during heavy rains. Fertility is high.

Most of the acreage is cultivated. Orchard fruit, vegetable crops, berries, small grain, and legumes grown for seed are the most important crops. Alfalfa and other hay crops are grown, and this soil is also used for pasture. Capability unit IIw-6; not placed in a woodland group; wildlife group 1.

Amity Series

The Amity series consists of somewhat poorly drained soils that formed in mixed old alluvium. These soils are on broad valley terraces. Slopes are 0 to 2 percent. Elevation ranges from 150 to 200 feet. Annual precipitation is 40 to 45 inches. Average annual air temperature is 52° to 54° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is grasses, rosebush, and scattered oak. Amity soils are associated with Willamette, Woodburn, Aloha, and Dayton soils.

In a representative profile, the surface layer is very dark grayish-brown silt loam about 14 inches thick. The subsurface layer is gray silt loam about 4 inches thick. The upper part of the subsoil is distinctly mottled grayish-brown silty clay loam about 8 inches thick. The lower part of the subsoil is distinctly mottled dark grayish-brown heavy silty clay loam about 10 inches thick. It is underlain by olive-brown silty clay loam that extends to a depth of more than 60 inches.

Amity soils are used for vegetable crops, small grain, hay, and pasture. They are also used for recreation, wildlife habitat, and homesites.

Amity silt loam (0 to 2 percent slopes) (Am).-This soil is extensive on the Willamette Valley terraces.

Representative profile about 40 feet South of county road NE1/4SW1/4 sec. 7, T. 5 S., R. 3 W.:

Ap-0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) when dry; moderate, fine, subangular blocky structure; friable, soft, slightly sticky and slightly plastic; many fine roots; many very fine interstitial pores; medium acid (pH 5.8) ; abrupt, smooth boundary. (5 to 8 inches thick)

A1-7 to 14 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) when dry; common, fine, faint, dark yellowish-brown and dark reddish-brown mottles; weak, medium, subangular blocky structure; friable, hard, slightly sticky and slightly plastic; many fine roots; common very fine pores; numerous, large, gray splotches and coatings on pcd surfaces; medium acid (pH 5.8) ; clear, smooth boundary. (5 to 10 inches thick)

A2-14 to 18 inches, gray (10YR 5/1) heavy silt loam, light brownish gray (10YR 6/2) when dry; many, fine, distinct, dark reddish-brown and dark yellowish-brown mottles; moderate, fine, subangular blocky structure; friable, hard, slightly sticky and plastic; common fine roots; common fine and medium pores; medium acid (pH 5.8) ; abrupt, smooth boundary. (4 to 8 inches thick)

B21t-18 to 26 inches, grayish-brown (10YR 5/2) silty clay loam, pale brown (10YR 6/3) when dry; many, fine, distinct, dark yellowish-brown mottles; weak, coarse, prismatic structure that parts to weak, medium, subangular blocky; firm, hard, sticky and plastic; common fine roots; many very fine pores; numerous gray coatings on red surfaces; thin patchy clay films on some ped surfaces; medium acid (pH 6.0) ; clear, smooth boundary. (4 to 9 inches thick)

B22t-26 to 36 inches, dark grayish-brown (2.5Y 4/2) heavy silty clay loam, pale brown (10YR 6/3) when dry; common, fine, distinct, yellowish-brown mottles; weak, coarse, prismatic structure that parts to weak, coarse, subangular blocky; firm, hard, sticky and plastic; few fine roots; common fine pores; medium and thick continuous clay films on ped surfaces; numerous gray coatings on ped surfaces; medium acid (pH 6.0) ; gradual, smooth boundary. (5 to 14 inches thick)

C-36 to 60 inches, olive-brown (2.5Y 4/4) silty clay loam, very pale brown (10YR 7/4) when dry; massive; firm, hard, sticky and plastic; few fine and medium pores; thick dark-brown clay films in pores; some Yellowish-brown splotches, and gray coatings and splotches throughout; slightly acid (pH 6.4).

The Al horizon has moist values of 2 and 3 and is mottled in the lower part. When moist, the Bt horizon has values of 4 and 5, chromas of 2 or 3, and hues of 10YR and 2.5Y.

Included with this soil in mapping are areas of Aloha, Woodburn, and Dayton soils. These included areas are less than an acre in size and occupy less than 5 percent of the total acreage.

This soil has moderately slow permeability. Roots can penetrate to a depth of more than 60 inches. The available water capacity is 11 to 13 inches. Tilth is good, but cultivation is restricted by a high water table during winter and early in spring. Surface runoff is slow, and during heavy rains this soil is slightly susceptible to sheet erosion. Fertility is moderate.

Most of the acreage is cultivated. Vegetables, small grain, grass seed, hay, and pasture plants are the important crops. Capability unit IIw-2; not placed in a woodland group; wildlife group 2.

Astoria Series

The Astoria series consists of well-drained. soils that formed on sedimentary rock in the Coast Range,. Slopes

range from 5 to 90 percent and are convex. Elevations range from 500 to 2,500 feet. Annual precipitation is 90 inches. Average annual air temperature is 49° F., and the frost-free season is 145 to 200 days. The vegetation is mainly Douglas-fir with some hemlock and an understory of vine maple, alder, and swordfern. The Astoria soils are associated with Hembre, Kilchis, Klickitat, and Ead soils.

In a representative profile, the surface layer is very dark brown and dark-brown heavy silt loam and silty clay loam about 16 inches thick. It is covered by a thin layer of moss, fir needles, and other forest litter. The subsoil is mainly strong-brown, friable silty clay. Fractured shale is at a depth of about 92 inches.

Astoria soils are used for timber, water supply, recreation, and wildlife habitat.

Astoria silt loam, 5 to 30 percent slopes (ASE).-This soil is on ridgetops and side slopes in the Coast Range. The areas on side slopes are strongly sloping to steep.

Representative profile in a stand of Douglas-fir near the summit of the Coast Range, approximately 350 feet east of State Highway 22; SW1/4,NW1/4SE1/4NE1/4 sec. 36, T. 5 S., R. 9 W.:

O1-1/2 inch to 0, moss, fir needles, twigs, fern leaves.

A11-0 to 6 inches, very dark brown (7.5YR 2/2) heavy silt loam, brown (7.5YR 4/2) when dry; moderate, fine, granular structure; friable, slightly hard, slightly sticky, slightly plastic; many fine roots; many fine and very fine pores; few fine iron and manganese concretions; very strongly acid (pH 4.9) ; clear, smooth boundary. (5 to 10 inches thick)

A12-6 to 16 inches, dark-brown (7.5YR 3/2) silty clay loam brown (7.5YR 4/3) when dry; moderate, fine, subangular blocky structure; friable, slightly hard, sticky, plastic; abundant fine roots; many fine and very fine pores; few fine concretions; few fine shale fragments; few very dark brown (7.5YR 2/2) streaks: very strongly acid (pH 4.8) ; clear, wavy boundary. (5 to 10 inches thick)

Bl-16 to 23 inches, dark-brown (7.5YR 3/4) silty clay loam, brown (7.5YR 5/4) when dry; moderate, fine, subangular blocky structure; friable, slightly hard, sticky, plastic; abundant fine roots; many fine and very fine pores; few fine shale fragments; very strongly acid (pH 4.8) ; clear, irregular boundary. (0 to 8 inches thick)

B21-23 to 37 inches, strong-brown (7.5YR 5/6) silty clay, yellow (10YR 7/6) when dry; moderate, fine, subangular blocky structure; friable, hard, sticky, plastic; common medium roots; many fine and very fine pores; few fine shale fragments; very strongly acid (pH 4.7) ; clear, wavy boundary. (9 to 14 inches thick)

B22-37 to 48 inches, strong-brown (7.5YR 5/6) silty clay, yellow (10YR 7/6) when dry; moderate, fine and very fine, subangular blocky structure; friable, hard, sticky, plastic; common medium roots; many fine and very fine pores; few fine shale fragments; very strongly acid (pH 4.6) ; gradual, wavy boundary. (10 to 15 inches thick)

B23-48 to 58 inches, strong-brown (7.5YR 5/6) silty clay, yellow (10YR 7/6) when dry; moderate, fine, subangular blocky structure; friable, hard, sticky, plastic; common medium roots; many fine and very fine pores; few very fine shale fragments; very strongly acid (pH 4.6) ; gradual, wavy boundary. (8 to 12 inches thick)

B24-58 to 78 inches, strong-brown (7.5YR 5/8) silty clay, yellow (10YR 7/6) when dry; weak, coarse, subangular blocky structure that breaks to moderate, fine, subangular blocky; mixed firm and friable, hard, sticky, plastic; few medium roots; many fine and very fine pores; many fine and very fine shale fragments; very strongly acid (pH 4.6) ; gradual, wavy boundary. (10 to 24 inches thick)

B3-78 to 92 inches, strong-brown (7.5YR 5/8) silty clay, yellow (10YR 7/6) when dry; weak to moderate. fine, subangular blocky structure; mixed firm and friable, hard, sticky, plastic; few medium roots; many fine and very fine pores; many fine and very fine shale fragments; very strongly acid (pH 4.6) gradual, wavy boundary. (0 to 18 inches thick)

R-92 to 100 inches, fractured shale rock; very strongly acid (pH 4.6).

The A horizon has moist values of 2 and 3, chromas of 2 or 3, and hues of 10YR and 7.5YR. Dry chromas range from 2 to 4. Structure is moderate or strong granular or fine to very fine, subangular blocky. The A horizon is silt loam in the upper part but ranges to silty clay loam in the lower part. Fine concretions are commonly present in the A horizon. When moist, the B horizon has values of 3 to 5, chromas of 4 to 8, and lines of 10YR to 7.5YR. Dry values are 4 to 7, and chromas are 4 through 8. The B horizon ranges from silty clay to clay. In places a few sedimentary rock fragments are in the upper part of the solum, and they increase in abundance with depth.

Included with this Astoria soil in mapping are areas of Ead, Hembre, and more steeply sloping Astoria soils. These areas are less than 5 acres in size and occupy less than 15 percent of the total acreage.

Permeability is moderate. Roots can penetrate to a depth of more than 40 inches. The available water capacity is 6 to 10 inches. The erosion hazard is moderate, and runoff is medium. Organic-matter content is high, and fertility is moderate.

This soil is used for timber, water supply, wildlife habitat, and recreation. Douglas-fir is the major species of tree, but hemlock grows in cooler areas where precipitation is greater. Capability unit VIe-2; woodland group 2c2; wildlife group 5.

Astoria silt loam, 30 to 60 percent slopes (ASF).-This steep soil is on the Coast Range. Runoff is rapid where the soil is cleared, and the hazard of erosion is severe. Douglas-fir and hemlock are the important species of trees. Capability unit VIe-3; woodland group 2c3; wildlife group 5.

Astoria silt loam, 60 to 90 percent slopes (ASG).-This very steep soil is on rough mountainous side slopes of the Coast Range. Most of the areas are closely associated with Hembre and Klickitat soils. This soil contains basalt pebbles and stones in places.

Included with this soil in mapping are small areas of soils that are less than 40 inches deep over siltstone and shale, and small areas that are less steep.

Runoff is rapid where this soil is cleared, and the hazard of erosion is very severe. Douglas-fir and some hemlock are the important trees. Capability unit VIIe-1; woodland group 2c3; wildlife group 5.

Briedwell Series

The Briedwell. series consists of well-drained soils that formed in old gravelly alluvium on high terraces. Gravel is at a depth of less than 36 inches. Slopes are 0 to 3 percent. Elevations are 200 to 320 feet. Animal precipitation is 40 to 45 inches, average annual air temperature is 52° F. and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is oak, Douglas-fir, and grasses. Briedwell soils are associated with Willamette, Woodburn, and Amity soils.

In a representative profile, the surface layer is dark-brown silt loam about 15 inches thick. The subsoil is dark yellowish-brown clay loam about 10 inches thick. It is underlain by mixed soil, gravel, and cobblestones that extend to a depth of more than 60 inches.

Briedwell soils are used for small grain, grass and clover seed, hay, and pasture. They are also used for wildlife habitat, recreation, and homesites.

Briedwell silt loam (0 to 3 percent slopes) (Br).-This soil is in the Sheridan and Newberg communities.

Representative profile about 20 feet west of the Red Prairie Road, 20 feet north of the Polk County line; NE1/4NE1/4SW1/4 sec. 3, T. 6 S., R. 6 W.:

Ap-0 to 9 inches, dark-brown (7.5YR 3/2) silt loam, brown (7.5YR 5/3) when dry; moderate, fine, subangular blocky structure; friable, slightly hard, slightly sticky, slightly plastic; many fine interstitial pores; many roots; 5 percent igneous rock pebbles; slightly acid (pH 6.2) ; abrupt, smooth boundary. (7 to 9 inches thick)

A11-9 to 15 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; weak, medium, prismatic that breaks to weak, medium and fine, subangular blocky structure; friable, slightly hard, slightly sticky, slightly plastic; many fine interstitial pores; many fine roots; 10 percent igneous rock pebbles; medium acid (pH 5.8) ; clear, smooth boundary. (5 to 11

B1-15 to 20 inches, dark yellowish-brown (10YR 3/4) light silty clay loam, yellowish brown (10YR. 5/4) when dry; moderate, fine, subangular blocky, that breaks to moderate, fine, granular structure; friable, slightly hard, slightly sticky, plastic; many fine interstitial pores; many fine roots; 15 percent igneous rock pebbles; medium acid (pH 5.8) ; clear, smooth boundary. (4 to 8 inches thick)

B2-20 to 25 inches, dark yellowish-brown (10YR 3/4) clay loam, yellowish brown (10YR 5/4) when dry; moderate, fine, subangular blocky structure; friable, hard, sticky, plastic; many, fine interstitial pores; common fine roots; few, thin, darker colored coatings or films on ped surfaces and in pores; 15 percent igneous rock pebbles; medium acid (pH 6.0) ; clear, smooth boundary. (4 to 8 inches thick)

IIC-25 to 60 inches, dark yellowish-brown (10YR 3/4) very gravelly clay loam, light yellowish brown (10YR 6/4) when dry; massive, firm, very hard, slightly sticky, plastic; many fine interstitial pores; 30 percent pebbles and 10 percent cobblestones below depth of 35 inches; fragments generally are rounded and embedded in soil material, and their surfaces are stained and weathered; medium acid (pH 6.0).

Hues in the A horizon are 7.5YR or 10YR, and chromas are 2 or 3. In the 13 horizon, hues are 10YR or 7.5YR, and moist values are 3 or 4. The B horizon ranges from heavy loam and clay loam to silty clay loam. Content of pebbles ranges from 0 to 15 percent in the solum and is as much as 60 percent below the solum. The weighted average content of coarse fragments between depths of 10 and 40 inches is 35 to 60 percent by volume. Coarse fragments are mostly of igneous and sedimentary rock.

There are no inclusions of other soils large enough to be significant.

This Briedwell soil is moderately permeable, and roots can penetrate to depths of 24 to 36 inches. The available water capacity is 6 to 7.5 inches. Tilth is good, and the soil can be cultivated throughout the year except during stormy periods in winter and spring. Surface runoff is slow, and erosion is a slight hazard during heavy rains. Fertility is moderate.

Most of the acreage is cultivated. Small grain, grass and clover seed, hay, and pasture plants are grown. Capability unit IIs-1; not placed in a woodland group; wildlife group 1.

Carlton Series

The Carlton series consists of moderately well drained soils that formed in mixed old alluvium and colluvium on low terraces and foot slopes. Slopes are 0 to 20 percent. Elevation ranges from 150 to 400 feet. Annual precipitation is 40 to 50 inches. Average annual air temperature is 51° to 54° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is mainly oak, poison-oak, and grasses. Carlton soils are associated with Chehalem and Cove soils on alluvial fans, Woodburn soils on terraces, and Willakenzie and Hazelair soils on the uplands.

In a representative profile, the surface layer is very dark grayish-brown silt loam about 12 inches thick. The upper part of the subsoil is mostly dark-brown firm silty clay loam to a depth of about 42 inches and is mottled in the lower 11 inches. The lower part of the subsoil is firm, mottled brown silty clay that extends to a depth of about 60 inches.

Carlton soils are used for orchards, berries, grain, hay, and pasture. They are also used for wildlife habitat, recreation, and homesites.

Carlton silt loam, 0 to 7 percent slopes (CaB).-This soil is on low terraces and foot slopes.

Representative profile on a west-facing slope near the top of a small hill, 30 feet west of road, NW1/4SE1/4SE1/4 sec. 18, T. 3 S., R. 3 W. :

Ap-0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) when dry; moderate, fine, subangular blocky structure; friable, hard, slightly sticky and slightly plastic; many fine irregular pores; many fine roots; medium acid (pH 6.0)
abrupt, smooth boundary. (6 to 9 inches thick)

A1-8 to 12 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) when dry; weak, fine and very fine, subangular blocky structure; friable, hard, slightly sticky and slightly plastic; many fine irregular pores; many fine roots; medium acid (pH 5.8) ; clear, smooth boundary. (4 to 6 inches thick)

B1-12 to 22 inches, very dark grayish-brown (10YR 3/2) heavy silt loam, grayish brown (10YR 5/2) when dry; moderate, fine and very fine, subangular blocky structure; firm, hard, sticky and plastic; many very fine irregular and tubular pores; common fine roots; strongly acid (pH 5.5) ; clear, smooth boundary. (6 to 1.5 inches thick)

B21-22 to 31 inches, dark-brown (10YR 4/3) light silty clay loam, pale brown (10YR 6/3) when dry; weak, coarse, prismatic structure that parts to moderate, fine to coarse, subangular blocky; firm, hard, sticky and plastic; many very fine tubular and irregular pores -, few fine roots; few, fine grayish-brown and light brownish-gray coatings; gray coatings, clean sand, and silt grains on ped surfaces; medium acid (pH 5.6) ; clear, smooth boundary. (8 to 15 inches thick)

B22-31 to 42 inches, dark-brown (10YR 4/3) light silty clay loam, pale brown (10YR, 6/3) when dry; many, fine, faint, yellowish-brown mottles; weak, medium, prismatic structure that parts to moderate, fine, subangular blocky; firm, hard, sticky and plastic; many very fine tubular pores; few fine roots; nearly con-

tinuous thin coatings of clean sand and silt grains on ped surfaces; medium acid (pH 5.6) ; clear, smooth boundary. (8 to 15 inches thick)

IIB3-42 to 60 inches, brown (10YR 5/3) silty clay, very pale brown fine, subangular blocky structure; firm, very hard, sticky and very (10YR 7/3) when dry; many, fine, faint, yellowish-brown mottles; weak, plastic; many very fine tubular pores; coatings of clean sand and silt grains on ped surfaces; medium acid (pH 5.8). clear smooth boundary

The solum ranges from 40 to more than 60 inches in thickness. Moist values of the A horizon are 2 or 3, and chromas are also 2 or 3. Moist values of the B horizon are 3 or 4 but are 3 to a depth of 20 inches or more. Chromas range from 2 to 4 but are 2 or 3 to a depth of at least 20 inches. In places, fine coatings that have values 2 to 3 units higher than those of the matrix occur throughout the A horizon and upper part of the B horizon. Mottles in the lower part of the B horizon are faint to distinct and range from yellowish brown to reddish brown. Texture in the B horizon ranges from heavy silt loam to silty clay loam to a depth of 35 inches, and from silty clay loam to silty clay below that depth.

Included with this soil in mapping are areas of Chehalem, Hazelair, and more steeply sloping Carlton soils. These areas are less than 2 acres in size and occupy less than 5 percent of the total acreage.

This Carlton soil has moderately slow permeability.Roots penetrate deeper than 60 inches. The available water capacity is 10 to 12 inches. Tilth is good, but cultivation is restricted during winter and early in spring by seepage and by a perched water table in the more nearly

Most of the acreage is cultivated. Small grain, hay, and pasture plants are the most important crops. Orchard trees and berries are grown where drainage has been improved. Vegetable crops are grown on a small acreage. Capability unit IIw-4; not placed in a woodland group; wildlife group 1.

Carlton silt loam, 7 to 12 percent slopes (CaC).-This soil is on foot slopes. Runoff is slow to medium, and there is a moderate erosion hazard in unprotected areas during rainy periods. Small grain, hay, and pasture plants are the major crops. Some areas where drainage has been improved are used for orchards. Capability unit IIIe-6; not placed in a woodland group; wildlife group 1.

Carlton silt loam, 12 to 20 percent slopes (CaD).-This soil is on foot slopes. Runoff is medium, and there is a severe erosion hazard in unprotected areas during rainy periods. Small grain, hay, and pasture plants are the major crops. Some areas where drainage has been improved are used for orchards. Capability unit IVe-4; not placed in a woodland group; wildlife group 1.

Chehalem Series

The Chehalem series consists of somewhat poorlydrained soils that formed in alluvium on alluvial fans. Slopes are 3 to 12 percent. Elevations range from 150 to 200 feet. Annual precipitation is 40 to 60 inches, average annual air temperature is 53° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated the vegetation is grass, rosebush, poison-oak, and oak.

The Chehalem. soils are associated with the Carlton soils and Cove soils on alluvial fans. They are adjacent to Willakenzie and Peavine soils on uplands and to Woodburn soils on terraces.

In a representative profile, the surface layer is very dark-brown silty clay loam about 23 inches thick. The subsoil is mottled very dark grayish-brown and very dark brown silty clay that contains fine rock fragments and is about 26 inches thick. It is underlain by variable layers of silty clay containing few to many rock fragments that extend to a depth of more than 60 inches.

Chehalem soils are used for small grain, hay, and pasture. They are also used for wildlife habitat and recreation.

Chehalem silty clay loam, 3 to 12 percent slopes (CeC).-This soil is on alluvial fans at the mouth of side draws.

Representative profile, 700 feet southwest along abandoned county road from Chehalem Valley Road; SW1/4 NW1/4NE1/4 sec. 6, T. 3 S., R. 3 W.:

Ap-0 to 7 inches, very dark brown (10YR 2/2) silty clay loam, dark gray (10YR 4/1) when dry; moderate, very fine, subangular blocky structure; friable, slightly hard, slightly sticky, slightly plastic; many roots; few fine and very fine pores; few fine siltstone particles; medium acid (pH 5.6) ; abrupt, clear boundary. (6 to 8 inches thick)

A1-7 to 11 inches, very dark brown (10YR 2/2) silty clay loam, dark gray (10YR 4/1) when dry; weak, very fine, subangular blocky structure; firm, slightly hard, slightly sticky, plastic; many fine roots; many very fine pores; few fine siltstone particles; medium acid (pH 5.8) ; abrupt, smooth boundary. (4 to 6 inches thick)

A3-11 to 23 inches, very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) when dry; moderate, fine, subangular blocky structure that parts to moderate, fine, granular; firm, slightly hard, sticky, plastic; many fine roots; many fine and very fine pores; few fine shale particles; medium acid (pH 5.8) ; clear, smooth boundary. (6 to 14 inches thick)

B21-23 to 36 inches, very dark grayish-brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) when dry; many, fine, distinct, yellowish or reddish-brown mottles; moderate, fine, subangular blocky structure; firm, hard, sticky, plastic; few fine roots; many very flne pores; few thin clay films or darker colored coatings on vertical ped surfaces; common, fine, light-colored, siltstone fragments; medium acid (pH 6.0) ; clear, smooth boundary. (6 to 15 inches thick)

B22-36 to 49 inches, very dark brown (10YR 2/2) silty clay, dark grayish brown (10YR 4/2) when dry; many, fine, distinct, yellowish or reddish-brown mottles; weak, fine, blocky structure; firm, very hard, sticky, plastic; many fine pores; few thin clay films or coatings on vertical ped surfaces; few siltstone fragments; medium acid (pH 5.8) ; gradual, smooth boundary. (8 to 15 inches thick)

C-49 to 60 inches, very dark grayish-brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) when dry; few, distinct, fine, reddish-brown mottles; massive; firm, very hard, sticky, plastic; few fine pores: many siltstone particles and fragments; medium acid (pH 6.0).

Hue in the A horizon is normally 10YR, but ranges to 7.5YR. Moist values are about 2, but may range to 3 in the A3 horizon. Texture of the A horizon ranges from silt loam, clay loam to silty clay loam. Mottling in the B horizon varies from faint to prominent. The B2 horizon ranges from 10YR to 2.5Y in hue. It has moist values of 2 or 3 and ranges to 4 below a depth of 24 inches. It has chromas of 2 throughout. Weathered, sedimentary coarse fragments normally are throughout the

profile, and make up as much as 40 percent of the lower part of the B horizon. Basalt fragments also occur in places.

Included with this soil in mapping are areas of Carlton and Cove soils on fans. These areas are less than an acre in size and make up less than 5 percent of the total acreage.

This Chehalem soil has slow permeability, and roots can penetrate to a depth of more than 60 inches. The available water capacity is 10 to 11 inches. Tilth is moderately good, but cultivation is restricted by seepage during winter and early in spring. Surface runoff is medium, and erosion is a slight to moderate hazard in unprotected areas during rainy periods. Fertility is moderate.

Most of the acreage is cultivated. Small grain, hay, and pasture plants are the most important crops. A small acreage is used for vegetable crops. Capability unit IIIe-6; not placed in a woodland group; wildlife group 1.

Chehalis Series

The Chehalis series consists of well-drained soils that formed in recent alluvium on bottom lands. Slopes are 0 to 3 percent. Elevations range from. 30 to 300 feet. Annual precipitation is 40 to 60 inches, average annual air temperature is 53° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is ash, cottonwood, and willow. Chehalis soils are associated with Cloquato, Newberg, Wapato, and Cove soils.

In a representative profile, the solum. is very dark grayish-brown, dark-brown, or dark yellowish-brown silty clay loam that extends to a depth of 56 inches. Below this is dark yellowish-brown silt loam that extends to a depth of 68 inches.

Chehalis soils are used mainly for vegetable crops, orchards, small grain, hay, and pasture. They are also used for wildlife habitat, recreation, and homesites.

Chehalis silty clay loam (0 to 3 percent slopes) (Ch).This soil is along the smaller streams and rivers and is adjacent to soils that are along the Willamette River.

Representative profile on Grand Island, 25 feet north of the road, SW corner of SW1/4NW1/4NW1/4NE1/4 sec. 22, T. 5 S., R. 3 W.:

Ap-0 to 7 inches, very dark grayish-brown (10YR 3/2) silty clay loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; friable, slightly hard, slightly sticky, plastic; many fine and medium roots; many very fine pores; slightly acid (pH 6.2) ; abrupt, smooth boundary. (6 to 10 inches thick)

A11-7 to 16 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) when dry; moderate, fine and very fine, subangular blocky structure; friable, slightly hard, slightly sticky, plastic; common fine roots; many very fine pores; slightly acid (pH 6.2)clear, smooth boundary. (6 to 10 inches thick)

A12-16 to 28 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; firm, hard, sticky, plastic; few fine roots; many very fine pores; medium acid (pH 6.0) ; clear, smooth boundary. (8 to 12 inches thick)

B21-28 to 41 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) when dry; weak, fine and medium, subangular blocky structure; firm, hard, sticky, plastic; many fine pores; few fine roots; medium acid (pH 5.8) ; clear, smooth boundary. (10 to 14 inches thick)

B22-41 to 56 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) when dry; weak, medium, subangular blocky structure; firm, hard, sticky, plastic; few fine roots; common fine pores; medium acid (pH 5.8) ; gradual, smooth boundary. (12 to 18 inches thick)

C-56 to 68 inches, dark yellowish-brown (10YR 3/4) silt loam; massive; firm, hard, slightly sticky, slightly plastic; few very fine pores; medium acid (pH 6.0).

The A horizon has moist color values of 3 and chromas of 2 or 3 to depths of 20 inches or more. The dry values are 4 or 5 and chromas are 2 or 3. In most places texture throughout the soil is silty clay loam, but thin, stratified layers of silt loam occur in places. In some places silt loam horizons are at depths of more than 40 inches.

Included with this soil in mapping are areas of Wapato and Cloquato soils. These areas are as much as 2 acres in size and make up less than 5 percent of the total acreage.

This Chehalis soil is moderately permeable, and roots can penetrate to a depth of more than 60 inches. Tilth is moderately good, and the soil can be cultivated throughout the year, except during stormy periods in winter and spring. The available water capacity is 11 to 13 inches. Surface runoff is slow, and the hazard of erosion is slight. Fertility is high.

Almost all the acreage has been cleared for cultivation.

Vegetable crops, berries, orchard fruit, and small grain are the principal crops. Alfalfa, grass and legume seed, hay, and pasture plants are also grown. Capability unit I-1; not placed in a woodland group; wildlife group 1.

Chehalis silty clay loam, overflow (0 to 3, percent slopes) (Ck).-This soil has a profile similar to that of Chehalis silty clay loam. It is subject to periods of overflow of short duration each winter.

Included with this soil in mapping are shallow, meandering overflow channels.

This soil is suited to a wide range of crops, but only crops that produce a good winter cover give protection during periods of overflow. Dikes also provide some protection during periods of overflow. Capability unit IIw-1; not placed in a woodland group; wildlife group 1.

Cloquato Series

The Cloquato series consists of well-drained soils that formed in recent alluvium on bottomlands along the larger streams. Slopes are 0 to 3 percent. Elevations range from 30 to 300 feet. Annual precipitation is 40 to 45 inches, the average annual air temperature is 53° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is ash, cottonwood, and willow. The Cloquato soil is associated with the Newberg and Chehalis soils.

In a representative profile, the surface layer is dark-brown silt loam about 12 inches thick. The upper part of the subsoil is dark-brown silt loam about 8 inches thick. The lower part of the subsoil is dark yellowish-brown silt loam about 28 inches thick. The substratum is dark yellowish-brown silt loam 12 inches or more thick.

Cloquato soils are used mainly for vegetable crops, orchards, small grain, hay, and pasture. They also are used for wildlife habitat and recreation.

Cloquato silt loam (0 to 3 percent slopes) (Cm)-This soil is in long narrow hands along streams.

Representative profile, 17 paces north and 64 paces east from the southwest corner of sec. 24, T. 5 S., R. 3 W.:

Apl-0 to 4 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; weak, fine, subangular blocky structure; friable, slightly hard, slightly sticky, slightly plastic; many fine roots; many very fine pores; slightly acid (pH 6.2) ; abrupt, smooth boundary. (3 to 4 inches thick)

Ap2-4 to 12 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; few small streaks of dark yellowish brown (10YR 3/4) when moist; weak, fine, subangular blocky structure; friable, slightly hard, slightly sticky, slightly plastic; many fine roots; many very fine pores; slightly acid (pH 6.2) ; abrupt, smooth boundary. (3 to 8 inches thick)

B2-12 to 20 inches, dark-brown (10YR 3/3) silt loam, yellowish brown (10YR 5/4) when dry; weak, fine, subangular blocky structure with moderate, fine, subangular blocky structure intermixed; friable, slightly hard, slightly sticky, slightly plastic; common fine roots; many very fine pores: slightly acid (pH 6.3) clear, smooth boundary. (8 to 12 inches thick)

B31-20 to 28 inches, dark yellowish -brown (10YR 3/4) silt loam, yellowish brown (10YR 5/4) when dry; weak, fine, subangular blocky structure; friable, slightly hard, slightly sticky, slightly plastic; many very fine and fine pores: few fine roots; scattered pockets and streaks of faint, mottled dark-gray and dark reddish-brown fine sandy loam and some small streaks and pockets of dark-gray sandy loam; slightly acid (pH 6.4) ; clear, smooth boundary. (7 to 12 inches thick)

B32-28 to 36 inches. dark yellowish-brown (10YR 3/4) silt loam, yellowish brown (10YR 5/4) when dry; weak, fine, subangular blocky structure: friable, slightly hard, slightly sticky, slightly plastic; many very fine and fine pores; few fine roots; scattered faint traces of variegated dark-gray streaks of very fine sandy loam: slightly acid (pH 6.4) ; gradual, smooth boundary. (0 to 8 inches thick)

B33-36 to 48 inches, dark yellowish-brown (10YR 3/4) silt loam, yellowish brown (10YR 5/4) when dry; weak., fine, subangular blocky structure; friable, slightly hard. slightly sticky, slightly plastic; few fine roots; many very fine and fine pores: slightly acid (pH 6.3) : gradual, smooth boundary. (0 to 12 inches thick)

C-48 to 60 inches, dark yellowish-brown (10YR 3/4) silt loam, yellowish brown (10YR 5/4) when dry; massive; friable, hard, slightly sticky, slightly plastic; very few roots: many very fine and fine pores; slightly acid (pH 6.4).

Texture is dominantly silt loam, but thin stratified layers of coarser material occur within a depth of 40 inches in places. A sandy substratum occurs below a depth of 40 inches in places.

Included with this soil in mapping are areas of Newberg and Chehalis soils and shallow, meandering overflow channels. These inclusions occupy less than 10 percent of the total acreage.

This Cloquato soil is moderately permeable, and roots can penetrate to a depth of more than 60 inches. The available water capacity is 11 to 13 inches. Tilth is good, and the soil can be cultivated throughout the year except during stormy periods in winter and spring. Surface runoff is slow, and the hazard of erosion is slight to moderate because of periodic overflow. Several times during winter the soil is flooded either by water that backs in as the river rises or by direct overflow. Fertility is high.

Almost all the act-cage has been cleared for cultivation. This soil is suited to a wide range of crops. Vegetables, berries, orchard fruit, and small grains are the principal crops. Alfalfa, grass, legumes for seed, hay, and pasture plants are also important. Capability unit IIw-1; not placed in a woodland group; wildlife group 1.

Cove Series

The Cove series consists of poorly drained, nearly level or gently sloping soils that formed in recent alluvium on bottom. lands and fans. The areas are smooth, and some are slightly concave. Depth to clay generally ranges front 7 to 24 inches, but some areas have clay throughout. Elevations range from 30 to 300 feet. Annual precipitation is 40 to 60 inches, average annual air temperature is 53° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is ash and willow, sedges, cattails, and grasses. Cove soils are associated with McBee and Chehalis soils.

In a representative profile, the surface layer is very dark gray silty clay loam about 8 inches thick. The subsoil is mottled very dark gray, very firm clay about 33 inches thick. It is underlain by mottled dark grayish-brown clay that extends to a depth of more than 60 inches.

Cove soils are used for hay and pasture and occasionally for spring grain and field corn. They are also used for wildlife habitat.

Cove silty clay loam (0 to 2 percent slopes) (Cn).-This soil is on nearly level or slightly concave bottom lands.

Representative profile about 50 feet north of the Amity-Bellevue road and 25 feet west of ditch; NE1/4 NW1/4SE1/4 sec. 25, T. 5 S., R. 5 W.:

Ap-A to 8 inches, very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) when dry; many, fine. distinct, yellowish-brown and dark reddish-brown mottles; moderate, fine, subangular blocky structure; firm, hard, sticky, plastic; common fine roots; conmon very tine and tine pores; medium acid (pH 5.6) abrupt, smooth boundary. (7 to 16 inches thick)

B21g-8 to 16 inches, very dark gray (10YR 3/1) clay, dark gray (N 4/0) when dry; many, fine, distinct, dark yellowish-brown and dark reddish-brown mottles; weak, medium, prismatic structure that parts to moderate, fine, subangular blocky; very firm, very hard, very sticky, very plastic; few fine roots; many very fine pores; slightly acid (pH- 6.1) : clear, smooth boundary. (7 to 10 inches thick)

B22g-16 to 41 inches, very dark gray (N 3/0) clay, dark gray (N 4/0) when dry; common, fine, faint, dark yellowish-brown mottles; moderate, medium and coarse, prismatic structure: very firm, very hard, very sticky, very plastic; few fine roots; common very fine pores; occasional slickensides that do not intersect; few scattered fragments of igneous rock and sedimentary rock; slightly acid (pH 6.4) ; clear, smooth boundary. (15 to 26 inches thick)

Cg-41 to 60 inches, dark grayish-brown (2.5Y 4/2) clay, gray (N 5/0) when dry; many, fine, dark reddish-brown and dark yellowish-brown mottles; massive; very firm, very hard, very sticky, very plastic; very few roots; common very fine pores; slightly acid (pH 6.4).

Depth to clay is 7 to 16 inches. Moist values are 2 or 3 and chromas are 1 or less throughout, except that in the A and C horizons chromas range to 2. Dry values are 4 or 5. Hues are predominantly 10YR in the A horizon but range to 2.5Y or neutral ; hues are generally 2.5Y or neutral in the B

horizon but range to 10YR. Structure is moderate or strong in the solum. Mottling is distinct or prominent within a depth of 20 inches. A few fine rock fragments occur in places.

Included with this soil in mapping are areas of Wapato and Labish soils. These areas are less than an acre in size and make up less than 5 percent of the total acreage.

This Cove soil is very slowly permeable, and roots seldom penetrate below a depth of 16 inches. It is difficult to cultivate except in summer. The available water capacity is 4 to 6 inches. Surface runoff is very slow, and ponding often occurs during winter. Overflow is common during winter. The erosion hazard is slight. Fertility is low.

Most of the acreage is cultivated. Hay and pasture plants are the principal crops. Spring grain is grown occasionally. Drainage by ditches and surface smoothing extend the season of use. Capability unit IVw-2; not placed in a woodland group; wildlife group 2.

Cove silty clay loam, thick surface (0 to 2 percent slopes) (Cs).-The profile of this soil is similar to that of Cove silty clay loam, except that the depth to clay ranges from 16 to 24 inches. Texture in the surface layer ranges from silty clay loam to silty clay. Available water capacity is 6 to 7.5 inches, and the fertility is moderately low. Hay and pasture plants are the principal crops, but spring grain and vegetable crops are also grown. Capability unit IIIw-2; not placed in a woodland group; wildlife group 2.

Cove silty clay loam, fan (2 to 7 percent slopes) (Co).-This soil is on alluvial fans. It has a profile similar to that of Cove silty clay loam. The lower part of the subsoil is 20 to 40 percent strongly weathered siltstone, shale, and a few basalt fragments. This soil is associated with the somewhat poorly drained Chehalem soils.

Included with this soil in mapping are areas less than an acre in size of similar soils that have a surface horizon as much as 24 inches thick over the clay subsoil. Also included are areas of a Chehalem soil that are as much as an acre in size.

Hay, pasture plants, and occasionally small grain are grown. This soil has a high water table caused by seepage from adjacent hills during winter and spring. Capability unit IVw-1; not placed in a woodland group; wildlife group 2.

Cove clay (0 to 2 percent slopes) (Cv).-This soil is similar to Cove silty clay loam except that the entire profile has a clay texture, and mottles are less common in the surface layer. Available water capacity is 3 to 4 inches. This soil is difficult to cultivate. It is used mainly for hay and pasture. Capability unit IVw-2; not placed in a woodland group; wildlife group 2.

Dayton Series

The Dayton series consists of poorly drained soils that formed in old alluvium on the Willamette Valley terraces. These soils have a smooth, level to slightly concave topography, and are limited in depth by a very firm clay subsoil. Elevation ranges from 150 to 200 feet. Annual precipitation is 40 to 45 inches, average annual air temperature is 53° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is grasses, sedges, rosebush, and widely spaced ash trees. Dayton soils are associated with Amity soils.

In a representative profile, the surface layer is grayish-brown silt loam about 7 inches thick. The subsurface layer is mottled grayish-brown silt loam about 8 inches thick. The subsoil is dark grayish-brown very firm clay about 13 inches thick and grayish-brown firm silty clay loam that extends to a depth of 60 inches or more.

Dayton soils are used for grass seed, spring grain, hay, pasture, and wildlife habitat.

Dayton silt loam (0 to 2 percent slopes) (Da).-This soil is on the Willamette Valley terraces.

Representative profile about 100 yards north of county road, about 200 yards cast of State Highway 154; SE1/4NE1/4NW1/4 sec. 7, T. 5 S., R. 3 W.:

Ap-0 to 4 inches, grayish-brown (10YR 5/2) silt loam, gray (10YR 6/1) when dry; few, fine, distinct, yellowish-brown mottles; moderate, fine and very fine, subangular blocky structure; friable, slightly hard, slightly sticky, slightly plastic; many fine roots; many very fine pores; few fine concretions; medium acid (pH 5.6) ; abrupt, smooth boundary. (4 to 7 inches thick)

A1-4 to 7 inches, grayish-brown (10YR 5/2) silt loam, gray (10YR 6/1) when dry; many, fine, distinct, yellowish-brown mottles; moderate, fine, subangular blocky structure; friable, slightly hard, slightly sticky, slightly plastic; many fine roots; many very fine pores; few fine concretions; medium acid (pH 5.6)
abrupt, smooth boundary. (1 to 3 inches thick)

A2-7 to 15 inches, grayish-brown (2.5Y 5/2) silt loam, light gray (10YR 7/2) when dry, many fine and medium, prominent, dark reddish-brown (5YR 3/4) mottles; moderate, fine and very fine, subangular blocky structure; firm, slightly hard, slightly sticky, slightly plastic; common fine roots; many very fine tubular pores; medium acid (pH 5.8); abrupt, smooth boundary. (4 to 15 inches thick)

IIB21t-15 to 21 inches, dark grayish-brown (2.5Y 4/2) clay, light brownish gray (10YR 6/2) when dry: moderate, medium, prismatic structure; very firm, extremely hard, very sticky, very plastic; common fine and very fine tubular pores: few fine roots; thin, continuous clay films; medium acid (pH 5.8) ; clear, smooth boundary. (5 to 12 inches thick)

IIB22t-21 to 28 inches, dark grayish-brown (2.5Y 4/2) clay, light brownish gray (10YR 6/2) when dry; many, fine, distinct, dark-brown mottles; moderate, medium, prismatic structure; very firm, extremely hard, very sticky, very plastic; many fine and very fine tubular pores; few fine roots; thin continuous clay films; medium acid (pH 6.0) ; clear, smooth boundary. (5 to 12 inches thick)

IIIB3-28 to 60 inches, grayish-brown (2.5Y 5/2) silty clay loam, very pale brown (10YR 7/3) when dry; many, fine, distinct, yellowish-brown mottles; weak, fine, subangular blocky and blocky structure; firm, hard, sticky, plastic: many fine tubular pores; thin continuous clay films in many root channels; slightly acid (pH 6.2).

Depth to the claypan is 12 to 18 inches. The Ap horizon has moist values of 4 and 5 and chromas of 1 and 2 in hue 10YR. Dry value is 6 and chromas are 1 and 2. The A2 horizon has moist values of 4 and 5 and chromas of 1 and 2. Structure ranges from weak to moderate prismatic in the B2t horizon.

Included with this soil in mapping are areas of Amity soils. These included areas are less than an acre in size and occupy less than 5 percent of the total acreage.

This soil has very slow permeability. Most roots are restricted by the very firm clay at depths of 12 to 18 inches. The available water capacity to the very firm clay is 3 to 4.5 inches, and to depths of 5 feet it is 6 to

7.5 inches. Tilth is good, but cultivation is restricted by a high water table late in fall, in winter, and in spring. Surface runoff is slow to ponded, and the hazard of erosion is slight. Fertility is low.

Most of the acreage has been cultivated. Grass seed, spring grain, hay, and pasture plants are the important crops. Capability unit IVw-3; not placed in a woodland group; wildlife group 2.

Dayton silt loam, thick surface (0 to 2 percent slopes) (Dc).-This soil is similar to Dayton silt loam, except that the surface layer is 18 to 24 inches thick over clay, and the subsurface layer is thicker.

The available water capacity to the very firm clay is 4.5 to 6 inches. Fertility is low to moderate.

In addition to the crops grown on Dayton silt loam vegetable crops are grown where this soil has been drained. Management practices are similar. Capability unit IIIw-1; not placed in a woodland group; wildlife group 2.

Dupee Series

The Dupee series consists of somewhat poorly drained soils underlain by sedimentary rock on uplands. These soils are gently sloping to moderately steep. Elevations range from 170 to 600 feet. Annual precipitation is 40 to 45 inches, average annual air temperature is 52° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is oak, rosebush, poison-oak, and grasses. Dupee soils are associated with Willakenzie, Panther, and Hazelair soils.

In a representative profile, the surface layer is dark-brown silt loam about 9 inches thick. The subsoil is mottled dark yellowish-brown and brown loam, firm clay, or heavy clay loam about 30 inches thick. The underlying material is pale-brown sandy clay loam. Partly weathered sandstone is at a depth of about 40 inches.

Dupee soils are used mainly for orchards, small grain, hay, and pasture. They are also used for wildlife habitat, recreation, homesites, and water supply.

Dupee silt loam, 3 to 12 percent slopes (DuC). This gently sloping to strongly sloping soil is in depressions and swales.

Representative profile in a filbert orchard, 100 yards north of the side road junction and 40 feet west of the Ribbon Ridge county road in the southeast corner of SE1/4SE1/4SE1/4 sec. 32, T. 2 S., R. 3 W.:

Ap-0 to 9 inches, dark-brown (10YR 3/3) light silt loam, brown (10YR 5/3) when dry; weak, coarse and medium, subangular blocky structure that parts to moderate, medium, subangular blocky; friable, slightly hard, nonsticky, slightly plastic; many fine roots: many fine irregular pores; strongly acid (pH 5.3) clear, smooth boundary. (6 to 9 inches thick)

B1-9 to 15 inches, dark yellowish-brown (10YR 4/4) loam, yellowish brown (10YR 4/4) when dry; few, fine, dark-brown (7.5YR 4/4) and dark yellowish-brown (10YR 3/4) coatings; moderate, medium and fine, subangular blocky structure; friable, hard, slightly sticky, slightly plastic; many fine roots; many very fine tubular pores; few thin films in channels; few fine fragments of sandstone; strongly acid (pH 5.2) ; clear, smooth boundary. (4 to 8 inches thick)

B21t-15 to 23 inches, dark yellowish-brown (10YR 4/4) heavy clay loam, yellowish brown (10YR 5/4) when dry; some dark yellowish-brown (10YR 3/4) coatings; weak, medium, prismatic structure that parts to moderate, medium and fine, subangular blocky; firm, hard, sticky, plastic; many fine roots; many very fine tubular pores; thin continuous clay films in pores; 1 percent fine sandstone fragments; very strongly acid (pH 4.9) ; clear, wavy boundary. (4 to 10 inches thick)

B22t-23 to 34 inches, dark yellowish-brown (10YR 4/4) heavy clay loam, yellowish brown (10YR 5/4) when dry; many, fine, distinct gray (10YR 5/1), grayish-brown (10YR 5/2), and reddish-brown (5YR 4/4) mottles; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky; firm, hard, sticky, plastic; common fine roots; many very fine tubular pores; thin continuous clay films on peds; 20 percent fine sandstone fragments; very strongly acid (pH 4.7) ; gradual, wavy boundary. (6 to 12 inches thick)

B23t-34 to 40 inches, brown (10YR 5/3) clay, very pale brown (10YR 7/3) when dry; many, fine, distinct, gray (10YR 5/1), grayish-brown (10YR 5/2) and strong-brown (7.5YR 5/6) mottles: moderate, medium, subangular blocky structure; firm, hard, sticky, very plastic; few fine roots; common fine and very fine tubular pores; many, medium, and few, thick clay films; 30 percent fine sandstone fragments; very strongly acid (pH 4.6) ; clear, irregular boundary. (6 to 15 inches thick)

C-40 to 51 inches, pale-brown (IOYR 6/3) partly weathered sandy clay loam sandstone, very pale brown (10YR 8/3) when dry; common, medium, prominent, strong brown (7.5YR 5/6) mottles; massive; very firm; very hard, sticky, plastic: few fine roots; few very fine tubular pores; thick clay films on horizontal planes; very strongly acid (pH 4.8) ; gradual, wavy boundary. (10 to 20 inches thick)

R-51 to 64 inches. variegated light-brown and light brownish-gray (10YR (3/3 and 2.5Y 6/2) partly weathered sandstone, very pale brown (10YR 8/3) when dry; massive.

Texture of the A horizon ranges from loam to silt loam. Texture of the B1 horizon ranges from clay loam to clay. The clay content in the upper 20 inches of the Bt horizon averages more than 35 percent. Mottles are distinct to prominent in the Bt horizon. Clay films are few and thin to thin and continuous on ped surfaces, and thin to thick continuous in the larger pores. In the lower part of the Bt horizon, the content of fine fragment of strongly weathered sedimentary rock ranges from very few to 50 percent.

Included with this soil in mapping are areas of Panther soils. These areas are less than an acre in size and occupy less than 2 percent of the total acreage.

This soil has moderately slow permeability. Roots can penetrate to bedrock, which is at depths of 40 to 60 inches. The available water capacity is 8 to 14 inches. Tilth is good, but cultivation is restricted during winter and early in spring by seepage and a perched water table. Surface runoff is slow to medium, and there is a moderate erosion hazard in unprotected areas during rainy periods. Fertility is moderate.

Most of the acreage is cultivated. Small grain, hay, and pasture plants are the most important crops. Orchard trees are grown where deep drains have been installed. Capability unit IIIe-6; not placed in a woodland group; wildlife group 3.

Dupee silt loam, 12 to 20 percent slopes (DuD).-This soil is similar to Dupee silt loam, 3 to 12 percent slopes, except that it is steeper. Runoff is medium, and erosion is a severe hazard in unprotected areas during rainy periods. Capability unit IVe-4; not placed in a woodland group; wildlife group 3.

Ead Series

The Ead series consists of well-drained soils that formed over sedimentary rock in the Coast Range. Slopes are 5 to 60 percent. Elevations are 400 to 1,000 feet. Annual precipitation is 60 to 70 inches, average annual air temperature is 49° F., and the frost-free season is 145 to 200 days. The vegetation is Douglas-fir, vine maple, alder, and swordfern. Ead soils are associated with Astoria and Peavine soils that also formed over sedimentary rock and with Knappa and Grande Ronde soils on terraces.

In a representative profile, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsoil is dark-brown, firm, silty clay or light clay about 15 inches thick. The substratum is firm, strong-brown silty clay. Very pale brown, pinkish-gray and reddish-yellow siltstone is at a depth of about 33 inches.

Ead soils are used for timber, water supply, wildlife habitat, and recreation.

Ead silty clay loam, 5 to 30 percent slopes (EAE).This soil is on the tops and sides of ridges in the eastern part of the Coast Range.

Representative profile on cutover land near Grand Ronde, about 15 feet north of a fire road, 150 yards southeast of fire road junction; NW1/4NE1/4NW1/4 sec. 5, T. 6 S., R. 8 W.:

Al-0 to 7 inches, very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) when dry; moderate and strong, very fine, subangular blocky structure; friable, hard, slightly sticky, plastic; many medium, fine, and very fine roots; many very fine irregular pores; very strongly acid (pH 5.0) abrupt, smooth boundary. (6 to 7 inches thick)

B21-7 to 13 inches, dark-brown (7.5YR 3/2) silty clay, dark brown (7.5YR 4/3) when dry; moderate, fine, subangular blocky structure; firm, hard, sticky, very plastic; common fine irregular pores; many fine roots; very strongly acid (pH 4.8) ; clear, smooth boundary. (5 to 8 inches thick)

B22-13 to 22 inches, dark-brown (7.5YR 3/3) light clay, dark brown (7.5YR 4/4) when dry; moderate, fine and very fine, subangular blocky structure; firm, hard, sticky, very plastic; many very fine irregular pores; common fine roots; few very fine siltstone fragments; very strongly acid (pH 4.6) ; clear, wavy boundary. (8 to 11 inches thick)

C-22 to 33 inches, strong-brown (7.5YR 5/6) silty clay, reddish yellow (7.5YR 6/6) when dry; weak, fine, subangular blocky structure; firm, hard, sticky, plastic; common fine irregular pores; few fine roots; 40 percent of the horizon is fragments of pinkish-gray (7.5YR 7/2) and reddish-yellow (7.5YR 6/6) siltstone; few yellowish-red (5YR 5/6) stains and coatings as much as 3 inches in diameter; extremely acid (pH 4.4) ; gradual, wavy boundary. (1 to 16 inches thick)

R-33 to 40 inches, very pale brown (10YR 7/3), pinkish-gray (7.5YR 7/2), and reddish-yellow (7.5YR 6/6) siltstone that has a few roots and thin dark-brown (7.5YR 4/4) films in fractures.

Moist value for the A horizon is dominantly 2 but ranges to 3. Chromas are 2 or 3 dry and moist. Hue ranges from 10YR to 7.5YR. Moist values of the B horizon are 3 but range to 4 in the lower part. Moist chromas are 2 and 3 but range to 4 in the lower part of the thicker soila; dry chromas range is predominantly 7.5YR, but ranges to 10YR. Texture ranges from silty clay to clay. Content of fine sedimentary rock fragments is 0 to 15 percent by volume. Hue in the C horizon generally is 7.5YR but ranges to 5YR. Moist values are 4 and 5, and chromas are 4 and 6. The boundary between the C and R horizons is gradual, commonly diffuse, and difficult to distinguish in some profiles, Depth to bedrock ranges from 20 to 40 inches, but is dominantly 25 to 35 inches.

Included with this soil in mapping are areas of Astoria, Hembre, and more steeply sloping Ead soils. These areas are less than 5 acres in size and occupy less than 15 percent of the total acreage.

This soil has moderate permeability. Roots can penetrate to depths of less than 40 inches. The available water capacity is 3 to 7 inches. Fertility is moderately low. The erosion hazard is moderate. Runoff is medium where the soil is cleared.

This soil is used mainly for timber. Douglas-fir is the major species. Capability unit VIe-2, woodland group 2c2; wildlife group 5.

Ead silty clay loam, 30 to 60 percent slopes (EAF).This steep soil is on the eastern part of the Coast Range. Runoff is rapid in cleared areas, and the hazard of erosion is severe. Douglas-fir is the important tree species. Capability unit VIe-3; woodland group 2c3; wildlife, group 5.

Fresh Water Marsh

Fresh water marsh (FW) is low-lying areas on the narrow stream bottoms in the Coast Range. It consists of a variety of soil materials and rock fragments mixed with roots, tree limbs, and other organic material. The water stands at or near the surface. The vegetation is sedges, skunk cabbage, and other water-tolerant plants. A few alder, willow, and cedar trees also grow on this land type. Capability unit VIIIw-1; not placed in a woodland group; wildlife group 5.

Grande Ronde Series

The Grande Ronde series consists of somewhat poorly drained soils that formed in old alluvium on terraces in small valleys. Slopes are 0 to 2 percent. Elevations are 300 to 500 feet. Annual precipitation is 60 to 80 inches, average annual air temperature is 49° F., and the frost-free period is 165 to 210 days. In areas that are not cultivated, the vegetation is oak, alder, willow, and grasses. Grande Ronde soils are associated with well-drained Knappa soils on terraces and Peavine and Ead soils on uplands.

In a representative profile, the surface layer is dark-brown silty clay loam about 6 inches thick. The subsoil is mottled dark-brown, yellowish-brown, and pale-brown, firm silty clay about 18 inches thick. It is underlain by yellowish-brown and light brownish-gray clay that extends to a depth of 60 inches or more.

Grande Ronde soils are used mainly for spring grain, grass seed, hay, and pasture. They are also used for water supply, wildlife habitat, and recreation.

Grande Ronde silty clay loam (0 to 2 percent slopes) (Gr).-This nearly level soil is on terraces.

Representative profile half a mile north of the Grand Ronde Agency store, 75 feet east of the road; NW1/4NW1/4NE1/4 sec. 1, T. 6 S., R. 8 W.:

Ap-0 to 6 inches, dark-brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) when dry; many, very fine, distinct, dark reddish-brown mottles; moderate, fine,

subangular blocky structure; friable, slightly hard, slightly sticky, plastic; many fine irregular pores; many fine roots; very strongly acid (pH 5.0) ; abrupt, smooth boundary. (5 to 10 inches thick)

B1-6 to 11 inches, dark-brown (10YR 4/3) heavy silty clay loam, pale brown (10YR 6/3) when dry; many, very fine, distinct, dark reddish-brown and reddish-brown mottles; moderate, fine, subangular blocky structure; friable, slightly hard, sticky, plastic; many fine irregular pores; common fine roots; very strongly acid (pH 4.8) ; clear, smooth boundary. (4 to 8 inches thick)

B21-11 to 18 inches, yellowish-brown (10YR 5/4) silty clay, very pale brown (10YR 7/3) when dry; many, fine, distinct, dark yellowish-brown mottles; moderate, fine, subangular blocky structure; firm, hard, sticky, plastic; many very fine and fine irregular and tubular pores; few fine roots; thin, patchy, dark-colored coatings on some ped surfaces; continuous gray coatings on some ped surfaces; continuous gray coatings of clean silt and fine sand grains on ped surfaces: very strongly acid (pH 4.6) ; clear, smooth boundary. (4 to 10 inches thick)

B22-18 to 24 inches, pale-brown (10YR 6/3) silty clay, very pale brown (10YR 7/3 and 8/3) when dry; many, fine, distinct, dark yellowish-brown mottles; weak, fine, subangular blocky structure; firm, hard, very sticky, plastic; many very fine tubular pores; few fine roots; many black coatings; continuous gray coatings of clean silt and fine sand grains on ped surfaces; very strongly acid (pH 4.6) ; clear, smooth boundary, (4 to 10 inches thick)

IICl-24 to 34 inches, yellowish-brown (10YR 5/6) clay, light yellowish brown (10YR 6/4) when dry; many distinct, gray mottles; massive; coarse prismatic structure when dry; very firm, very hard, very sticky, very plastic; few very fine pores; very strongly acid (pH 4.5) ; clear, smooth boundary. (8 to 15 inches thick)

IIC2-34 to 60 inches, light brownish-gray (2.5Y 6/2) clay, light gray (2.5Y 7/2) when dry; many, fine distinct, yellowish-brown mottles; massive; very firm, very hard, very sticky, very plastic; few very fine pores; common fine fragments of sedimentary rock; few pebbles of igneous rock; few, small, black coatings on some vertical fractures; very strongly acid (pH 4.6).

The A horizon has no or few faint or distinct mottles, a 10YR hue, and moist chromas of 2 or 3. The B horizon has moist values of 4 to 6. Texture ranges from silty clay to clay, and the structure is weak or moderate. Mottles are distinct or prominent at depths of less than 20 inches. The underlying IIC horizon is massive or has weakly prismatic structure. In some places it contains fragments of siltstone and shale and pebbles of basalt. These fragments and pebbles generally are most abundant in the deepest horizons, where they make up as much as 20 percent of the soil by volume.

This Grande Ronde soil has slow permeability. Roots can penetrate readily to the very firm clay, which is at depths of 22 to 36 inches. The available water capacity is .5 to 7.5 inches. Tilth is moderate, but cultivation is restricted during winter and spring by a perched water table. Surface runoff is slow. Slight sheet erosion occurs during rainy periods. Fertility is low.

Most of the acreage is cultivated. Grass seed, hay, and pasture plants are the principal crops. Spring grain is also grown. Capability unit IIIw-4; not placed in a woodland group; wildlife group 2.

Hazelair Series

The Hazelair series consists of somewhat poorly drained soils that formed in mixed material over sedimentary rock. These soils are on low hills. Slopes are 2 to 20 percent. Elevations are 250 to 650 feet. Annual precipitation is 40 to 60 inches, average annual air temperature is 52° to 54° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is oak, poison-oak, and grasses. Hazelair soils are associated with Willakenzie, Steiwer, Dupee, and Panther soils.

In a representative profile, the surf ace layer is dark-brown and dark yellowish-brown silty clay loam about 11 inches thick. The subsoil is mottled in the lower part and is dark-brown silty clay about 7 inches thick. It is underlain by light olive-brown and grayish-brown clay. Sandstone is at a depth of about 30 inches.

Hazelair soils are used mainly for spring grain, hay, and pasture. They are also used for wildlife habitat and water supply.

Hazelair silty clay loam, 2 to 7 percent slopes (HcB).This gently sloping soil is on low hills.

Representative profile 100 yards east of the road in the northwest corner of NW1/4NW1/4NE1/4 sec. 29, T. 2 S., R. 4 W.:

Ap-0 to 7 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; friable, hard, sticky, plastic; many very fine pores; many fine roots; medium acid (pH 5.8) ; abrupt, smooth boundary. (6 to 10 inches thick)

A1-7 to 11 inches, dark yellowish-brown (10YR 3/4) silty clay loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; friable, hard, sticky, plastic; many very flue pores; many fine roots; medium acid (pH 5.6) ; abrupt, smooth boundary. (3 to 6 inches thick)

B2-11 to 18 inches, dark-brown (10YR 4/3) silty clay, brown (10YR 5/3) when dry; few, fine, distinct mottles in the lower part; moderate, fine, subangular blocky structure; firm, hard, very sticky, plastic; many very fine pores; many fine roots; few thin clay films in some pores; few fine fragments of siltstone and sandstone; strongly acid (pH 5.4) ; abrupt, smooth boundary. (3 to 10 inches thick)

IIC1-18 to 24 inches, light olive-brown (2.5Y 5/4) clay, light gray (2.5Y 7/2) and pale yellow (2.5Y 7/4) when dry; many, fine, faint and distinct, yellowish-brown (10YR 5/4) and grayish-brown (10YR 5/2) mottles; weak, coarse, prismatic structure; very firm, very hard, very sticky, very plastic; common very fine pores; few fine roots; many, fine and very fine, yellowish-brown, weathered fragments of siltstone and sandstone; strongly acid (pH 5.2) ; clear, smooth boundary. (5 to 7 inches thick)

IIC2-24 to 30 inches, grayish-brown (2.5Y 5/2) clay, light gray (2.5Y 7/2) when dry; massive; very firm, very hard, very sticky, very plastic; few fine pores; few fine and medium roots; common, fine and very fine, weathered fragments of siltstone and sandstone; strongly acid (pH 5.2) ; abrupt, wavy boundary. (5 to 6 inches thick)

IIIR-30 inches, brownish-yellow (10YR 6/6) sandstone that has light-gray (10YR 7/1) lenses and light brownish-gray (10YR 6/2) clay in fracture planes.

Texture of the A horizon ranges from silt loam to silty clay loam. The A horizon has hues of 10YR and 7.5YR. Moist values are 2 or 3 and chromas are 2 or 3 in the upper 7 inches, and 3 or 4 below 7 inches. Dry chromas are 2 to 4. The B horizon has moist values of 3 or 4 and chromas of 2 to 4. Hue is predominantly 10YR, but ranges to 7.5YR and 2.5Y. In places a few fine fragments of siltstone and sandstone are embedded in the lower part of the B horizon. Hue in the underlying clay horizons is predominantly 2.5Y, but ranges to 7.5YR where the sandstone and siltstone are more red than typical. Moist values are 4 to 6.

Included with this soil in mapping are areas of Hazelair soils that have slopes of more than 7 percent. Also included are Carlton and Willakenzie soils. Areas of included soils are less than 2 acres in size and make up less than 5 percent of the total acreage.

This Hazelair soil has slow permeability. Roots can penetrate readily to the clay, which is at depths of 12 to 24 inches. The available water capacity is 4 to 7 inches. Tilth is fair, and cultivation is restricted during winter and early in spring by seepage. Surface runoff is slow, and erosion is a slight hazard in unprotected areas during rainy periods. Fertility is low.

About half the acreage of this soil is cultivated. Spring grain, hay, and pasture plants are grown. Capability unit IIIe-3; not placed in a woodland group; wildlife group 3.

Hazelair silty clay loam, 7 to 20 percent slopes (HcD).-This soil is similar to Hazelair silty clay loam, 2 to 7 percent slopes, and is used for similar crops. Runoff is medium, and erosion is a severe hazard in unprotected areas during rainy periods. Capability unit IVe-3; not placed in a woodland group; wildlife group 3.

Hazelair Series, Acid Variant

Acid variants from the Hazelair series are moderately well drained and are gently sloping. They formed in mixed material on high terraces and fans. These soils have a very firm claypan at some depth between 24 and 32 inches. Elevations range from 300 to 400 feet. Annual precipitation is 50 to 60 inches, average annual air temperature is 49° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is mainly Douglas-fir, oak, and wild rose. These soils are associated with Peavine and Ead soils on uplands and Knappa soils on terraces.

In a representative profile, the surface layer is dark-brown silty clay loam about 11 inches thick. The subsoil is dark-brown silty clay loam to silty clay, about 15 inches thick, that is mottled in the lower part. It is underlain by a dark-brown clay. Fractured siltstone is at a depth of about 36 inches.

These soils are used mainly for spring grain, grass seed, hay, and pasture. They are also used for wildlife habitat and water supply.

Hazelair silty clay loam, acid variant, 2 to 7 percent slopes (HeB).-This soil is on high terraces and fans. It is moderately well drained.

Representative profile about 250 feet northeast of the road corner; SW1/4NE1/4SE1/4 sec. 23, T. 5 S., R. 7 W.

O1-1/4 inch to 0. fir needles. leaves. twigs. etc.

A1-0 to 11 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; friable, hard, sticky, slightly plastic; many very fine pores; many fine and medium roots; very strongly acid (pH 5.0) ; clear, smooth boundary. (9 to 16 inches thick)

B1-11 to 14 inches, dark-brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) when dry; moderate, medium, subangular blocky structure; firm, hard, sticky, plastic; many very fine pores; many very fine roots; extremely acid (pH 4.4) ; abrupt, smooth boundary. (0 to 5 inches thick)

B21-14 to 20 inches, dark-brown (7.5YR 4/4) silty clay, pale brown (10YR 6/3) when dry; moderate, fine and medium, subangular blocky structure; firm, hard, very sticky, plastic; many very fine pores; common very fine roots; common very fine fragments of siltstone; extremely acid (pH 4.4) ; clear, smooth boundary. (3 to 7 inches thick)

B22-20 to 26 inches, dark-brown (7.5YR 4/4) heavy silty clay, light yellowish brown (10YR 6/4) when dry; few, fine and very fine, distinct, light brownish-gray (10YR 6/2) mottles and coatings, few, fine, faint, yellowish-brown (10YR 5/4) mottles; strong, fine and very fine, subangular blocky structure; firm, hard, very sticky, very plastic; common fine pores; few fine roots; common very fine fragments of siltstone; very strongly acid (pH 4.6) ; abrupt, smooth boundary. (2 to 7 inches thick)

IIC-26 to 36 inches, dark-brown (7.5YR 4/4 clay, light yellowish brown (10YR 6/4) when dry; many, very fine, distinct, light brownish-gray (10YR 6/2) mottles and coatings; weak, fine, subangular blocky structure; very firm, very hard, very sticky, very plastic; many very fine pores; few fine roots; thin patchy films on some ped surfaces and root channels: 30

IIR-36 inches variegated strong-brown (7.5YR 5/6). light-gray (10YR 7/2), and pale-brown (10YR 6/3) fractured siltstone; thin, nearly continuous, reddish-colored clay films in fracture planes; few fine roots in fractures.

The A horizon has chromas of 2 or 3. Very fine siltstonefragments range from few to many throughout the solum. The unconformable, very firm clay horizon has moist values of 4 through 6 and chromas of 2 through 4. Very fine and fine siltstone fragments make up 20 to 40 percent of the volume. Structure ranges from weak prismatic to weak subangular blocky, or is massive. The boundary with siltstone normally is clear, but in fan positions the boundary is quite diffuse and in places more than 80 percent of the lower part of the overlying layer is siltstone fragments.

Included with this soil in mapping are areas of Knappa soils. These areas are less than 2 acres in size and make up less than 5 percent of the total acreage.

The Hazelair variant has slow permeability. Roots can penetrate readily to depths of 24 to 32 inches. The available water capacity is 5 to 7 inches. Tilth is moderate, but cultivation is restricted during winter and early in spring by seepage. Surface runoff is slow, and erosion is a slight hazard in unprotected areas during rainy periods. Fertility is low.

Most of the acreage has been cultivated. Spring grain, grass seed, hay and pasture plants are the principal crops. Capability unit IIIe-3; not placed in a woodland group; wildlife group 3.

Hembre Series

The Hembre series consists of well-drained soils that formed over basalt in the Coast Range. Slopes range from 3 to 90 percent and are convex. Elevations range from 500 to 2,800 feet. Annual precipitation is 80 to 110 inches. Average annual air temperature is 49° F., and the frost-free period is 145 to 200 days. The vegetation is Douglas-fir, hemlock, alder, swordfern, and vine maple. Hembre soils are associated with Kilchis, Klickitat, and Astoria soils.

In a representative profile, the surface layer is dark reddish-brown silt loam that has common shot-sized concretions and is about 12 inches thick. The subsoil is dark reddish-brown, reddish-brown, and yellow-red friable

silty clay loam about 32 inches thick. It is underlain by hard basalt bedrock at a depth of about 44 inches.

Hembre soils are used for timber, water supply, recreation, and wildlife habitat.

Hembre silt loam, 3 to 30 percent slopes (HBE).-This soil is rolling to steep. It is on ridgetops and on side slopes in the Coast Range.

Representative profile a quarter mile north of Neverstill junction with the Turner Creek Road, 150 feet east of road; NW1/4SE1/4SE1/4 sec. 1, T. 2 S., R. 6 W.:

O-1/8 inch to 0, needles, twigs, leaves.

A1-0 to 5 inches, dark reddish-brown (5YR 3/2) silt loam, dark brown (7.5YR 4/4) when dry; strong, fine, granular structure; friable, soft, slightly sticky, slightly plastic; many fine roots; many very fine irregular pores; common very fine fragments of basalt; common very fine concretions (shot) ; strongly acid (pH 5.2) clear, smooth boundary. (4 to 6 inches thick)

A3-5 to 12 inches, dark reddish-brown (5YR 3/2) silt loam, brown (7.5YR 5/4) when dry; moderate, fine, subangular blocky structure; friable, soft, slightly sticky, slightly plastic; many fine roots; many very fine pores; common very fine fragments of basalt; common very fine concretions (shot) ; very strongly acid (pH 5.0) ; clear, smooth boundary. (6 to 8 inches thick)

B21-12 to 19 inches, dark reddish-brown (5YR 3/4) silty clay loam, reddish yellow (7.5YR 6/6) when dry; moderate, fine, subangular blocky structure; friable, slightly hard, slightly sticky, plastic; common fine roots; common very fine pores; few fine concretions (shot) ; very strongly acid (pH 4.8) ; clear, smooth boundary. (7 to 10 inches thick)

B22-19 to 30 inches, reddish-brown (5YR 4/4) silty clay loam, reddish yellow (7.5YR 6/6) when dry; moderate, fine, subangular blocky structure; friable, slightly hard, slightly sticky, plastic; few fine roots; common very fine pores; few fine fragments of basalt; few fine concretions (shot) ; very strongly acid (pH 4.8); clear, smooth boundary. (9 to 12 inches thick)

B3--30 to 44 inches, yellowish-red (5YR 4/6) gravelly silty clay loam, reddish yellow (5YR 6/6) when dry; weak, fine, subangular blocky structure; firm, hard, slightly sticky, plastic; few medium roots: common very fine pores; 40 percent coarse fragments of basalt; very strongly acid (pH 4.8) ; abrupt, wavy boundary. (14 to 16 inches thick)

R-44 inches, basalt bedrock that has a few fractures.

The A horizon has moist values of 2 and 3; chromas are 2 to 3 moist and 3 or 4 dry; hues are 7.5YR and 5YR. The, B horizon has chromas of 4 and 6 in hues of 7.5YR and 5YR.Pebbles and cobblestones of basalt make up as much as 15 percent of the A and B2 horizons and up to 40 percent of the B3 horizon.

Included with this soil in mapping are areas of Klickitat soils and more steeply sloping Hembre soils of as much as 10 acres in size, and areas of Astoria and Kilchis soils of less than 5 acres. These areas make up less than 15 percent of the total acreage.

Hembre soils have moderate permeability. Roots can penetrate to bedrock. The available water capacity is 7 to 10 inches. Organic-matter content is moderately high, and fertility is moderate. Surface runoff is slow to medium, and the erosion hazard is moderate.

This soil is used primarily for timber. The important trees are Douglas-fir and hemlock in the cooler, more moist areas and noble fir at high elevations. Management can be intensive (fig. 9). Capability unit VIe-2; woodland group 2o2; wildlife group 5.

Hembre silt loam, 30 to 60 percent slopes (HBF).This soil is on the Coast Range. Runoff is rapid in cleared areas, and the erosion hazard is severe. Douglas-fir and hemlock are the important trees. Management is moderately difficult. Capability unit VIe-3; woodland group 2r2; wildlife group 5.

Hembre silt loam, 60 to 90 percent slopes (HBG).-This soil is on the rough mountainous part of the Coast Range. Runoff is rapid in cleared areas, and the erosion hazard is severe.

Included with this soil in mapping are areas along the lower slopes that are deeper than normal, and other areas that are shallow and stony throughout. These inclusions range to 10 acres in size and occupy as much as 20 percent of the total acreage.

Douglas-fir and hemlock are the important trees. Management is very difficult. Capability unit VIIe-1; woodland group 2r3; wildlife group 5.

Jory Series

The Jory series consists of well-drained soils that formed in colluvium derived from basalt rock. These soils on low foothills and have slopes of 2 to 90 percent. Elevations range from 250 to 1,200 feet. Annual precipitation is 40 to 60 inches. Average annual air temperature is 52° to 54° F., and the frost-free period is 165 to 210 days. In areas that are not cultivated, the vegetation is Douglas-fir, oak, poison-oak, and grasses. Jory soils are associated with Nekia, Yamhill, Peavine, and Willakenzie soils.

In a representative profile, the surface layer is dark reddish-brown clay loam or silty clay loam about 21 inches thick. The subsoil is dark reddish-brown clay about 47 inches thick. Depth to basalt is more than 40 inches.

Jory soils are used mainly for orchards, berries, grain, hay, pasture, and timber. They are also used for wildlife habitat, water supply, recreation, and homesites.

Jory clay loam, 2 to 7 percent slopes (JrB).-This gently sloping soil is on smooth ridgetops.

Representative profile on the Dundee Hills about 60 feet northeast of road junction; NW1/4NW1/4SW1/4 sec. 26, T. 3 S., R. 3 W.:

Ap-0 to 7 inches, dark reddish-brown (5YR 3/3) clay loam, reddish brown (5YR 4/3) when dry; moderate, fine, granular structure; friable, slightly hard, sticky, plastic; many fine roots; many very fine irregular pores; common fine and very fine concretions; medium acid (pH 5.8) ; abrupt, smooth boundary. (5 to 8 inches thick)

A1-7 to 15 inches, dark reddish-brown (5YR 3/3) silty clay loam, reddish brown (5YR 4/4) when dry; strong, fine, granular structure; friable, slightly hard, sticky, plastic; common fine roots; many very fine irregular pores; many fine concretions; medium acid (pH 5.8) ; clear, smooth boundary. (4 to 12 inches thick)

A3-15 to 21 inches, dark reddish-brown (5YR 3/3) heavy silty clay loam, reddish brown (5YR 4/4) when dry; strong, fine, granular and subangular blocky structure; friable, slightly hard, sticky, plastic; common fine roots; many very fine irregular pores; common fine concretions; medium acid (pH 5.6) ; clear, smooth boundary. (3 to 7 inches thick)

B21t-21 to 28 inches, dlark reddish-brown (5YR 3/4) clay, reddish brown (5YR 4/4) when dry; moderate, fine, subangular blocky structure: very firm, very hard, very sticky, very plastic; common fine roots; many

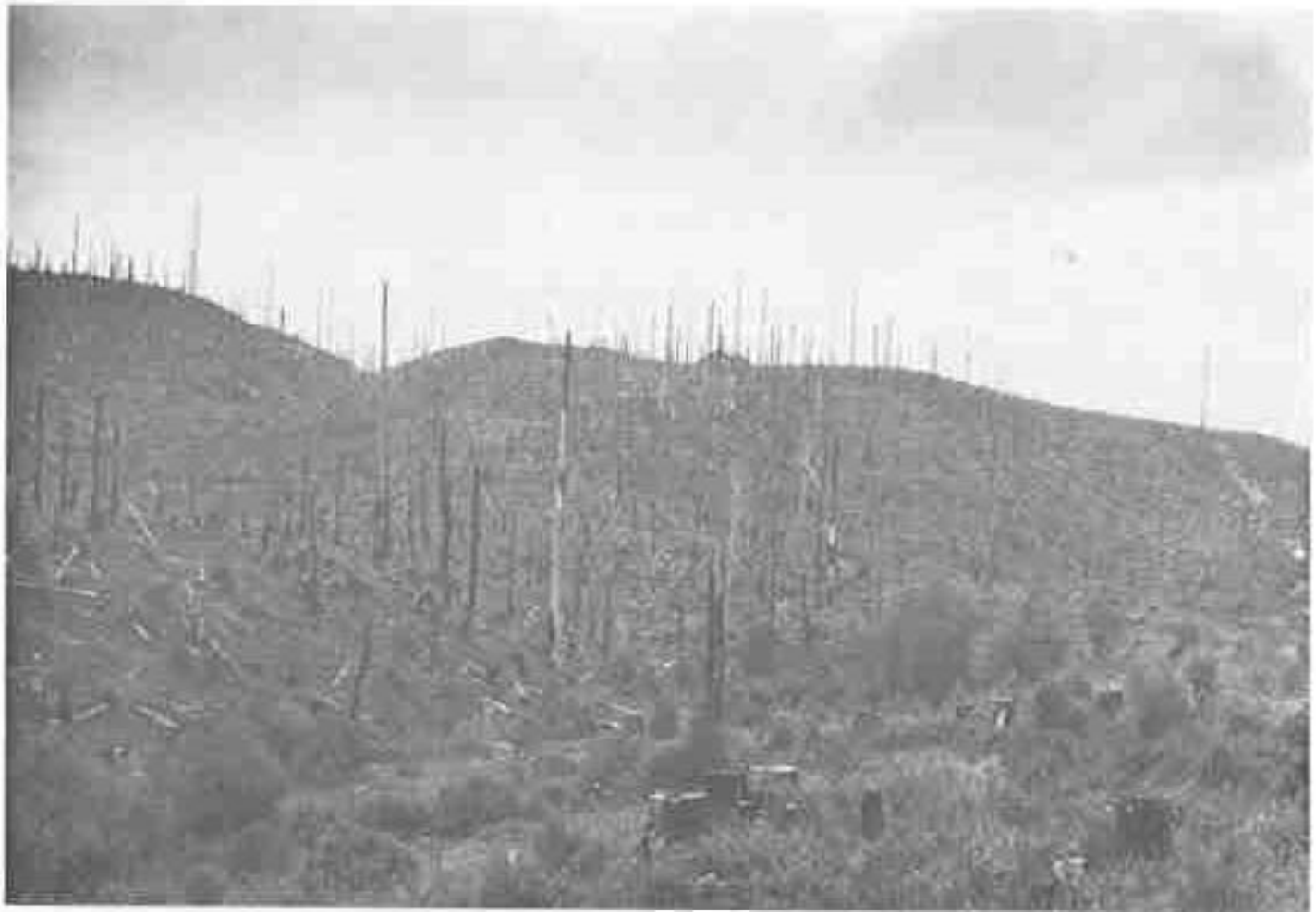

Figure 9.-Area of Hembre silt loam, 3 to 30 percent slopes, that was burned over by forest fires 30 years ago. Lack of a source of seed is largely responsible for the poor natural reforestation.

very fine pores; few thin clay films on ped surfaces and in pores; few fine concretions; strongly acid (pH 5.4) ; clear, smooth boundary. (6 to 15 inches thick)

B22t-28 to 39 inches, dark reddish-brown (2.5YR 3/4) clay, reddish brown (2.5YR 4/4) when dry; moderate, medium, subangular blocky structure; very firm, very hard, very sticky, very plastic; few fine roots; common fine pores; many, thin, black stains; many, thin and medium, patchy clay films on ped surfaces; few fine concretions; few fine fragments of basalt; strongly acid (pH 5.2) ; clear, smooth boundary. (10 to 20 inches thick)

B23t-39 to 56 inches, dark reddish-brown (2.5YR 3/4) clay, reddish brown (2.5YR 4/4) when dry; moderate, fine, subangular blocky structure; very firm, very hard, very sticky, very plastic; few fine roots; common very fine pores; thin and moderately thick continuous clay films on ped surfaces; many, fine and medium, black stains; few fine concretions; few fine fragments of basalt; very strongly acid (pH 5.0) ; gradual, smooth boundary. (12 to 36 inches thick)

B3-56 to 68 inches, dark reddish-brown (2.5YR 3/4) clay, reddish brown, (2.5YR 4/4) when dry; weak and moderate, fine, subangular blocky structure; very firm, very hard, very sticky, very plastic; common fine tubular pores; few thin clay films on ped surfaces and in pores; common, fine, black stains; about 3 percent fine fragments of basalt; strongly acid (pH 5.2).

In the upper part of the A horizon, moist values are 2 and 3, chromas are 3 and 4, and hue is 5YR. Dry chromas are 3 to 6. The B horizon, below a depth of 20 inches, has moist values of 3 and chromas of 4 and 6 in hues of 5YR and 2.5YR. In places the B3 horizon is absent and the B2 horizon is underlain directly by basalt. Depth to basalt is commonly more than 60 inches, but is as shallow as 40 inches in places. Stones and boulders are in the profile in some areas.

Included with this soil in mapping are areas of gently sloping Nekia soils that occupy about 10 percent of the acreage. More steeply sloping Jory and Nekia soils, and Yamhill and Willakenzie soils in areas less than 2 acres in size occupy less than 5 percent of the total acreage.

This Jory soil is well drained and has moderately slow permeability. Roots can penetrate to a depth of more than 40 inches. The available water capacity is 7 to 11 inches. Tilth is good, and the soil can be cultivated throughout the year except during storms in winter and spring. Surface runoff is slow, and erosion is a slight hazard in unprotected areas during rainy periods. Fertility is moderate.

Most of the acreage, is cultivated. Orchard fruit, grain, hay, and pasture plants are the principal crops. Berries

and grass for seed are also grown. Capability unit IIe-3; woodland group 3cl; wildlife group 3.

Jory clay loam, 7 to 12 percent slopes (JrC).-This soil is used for crops similar to those grown on Jory clay loam, 2 to 7 percent slopes. Runoff is slow to medium, and the erosion hazard is moderate in unprotected areas during rainy periods. Capability unit IIIe-2; woodland group 3cl; wildlife group 3.

Jory clay loam, 12 to 20 percent slopes (JrD).-This soil is used for crops similar to those grown on Jory clay loam, 2 to 7 percent slopes. Runoff is medium, and the erosion hazard is moderate in unprotected areas during rainy periods. This soil is not well suited to houses that have septic tanks because seepage of effluent on the moderately steep slopes is a hazard. Capability unit IIIe-2; woodland group 3cl; wildlife group 3.

Jory clay loam, 20 to 30 percent slopes (JrE).-This soil is used for about the same crops as are grown on Jory clay loam, 2 to 7 percent slopes, except that berries are not grown. Runoff is medium, and the erosion hazard is severe during rainy periods. Capability unit IVe-2; woodland group 3cl; wildlife group 3.

Jory clay loam, 2 to 30 percent slopes (JRE).-This soil is mapped in woodland areas. Runoff is slow to medium, and the erosion hazard is slight to severe.

This soil is used mainly for timber but would be suitable for cultivation if cleared. Woodland can be managed intensively. Capability unit IVe-2; -woodland group 3cl; wildlife group 4.

Jory clay loam, 30 to 60 percent slopes (JRF).-Some areas of this mapping unit are in the part of the survey area that was mapped at high intensity.

Included with this soil in mapping are areas of less steep Nekia and Jory soils and Stony land. These areas are as large as 5 acres in size and make up 15 percent of this mapping unit.

Runoff is medium, and the erosion hazard is severe in unprotected areas during rainy periods. This soil is used mainly for timber and pasture. Management is moderately difficult. Capability unit VIe-5; woodland group 3c2; wildlife group 4.

Jory clay loam, 60 to 90 percent slopes (JRG).-This soil is similar to Jory clay loam, 2 to 7 percent slopes, but it contains more stones and boulders and has very steep slopes.

Included with this soil in mapping are areas of less steep Nekia and Jory soils and Stony land. These areas are as large as 5 acres in size and occupy 15 percent of this mapping unit.

Runoff is rapid, and the erosion hazard is severe in unprotected areas during rainy periods. This soil is used mainly for timber. Management is very difficult. Capability unit VIIe-1; woodland group 3c2; wildlife group 4.

Kilchis Series

The Kilchis series consists of excessively drained soils that formed on basalt in the Coast Range. The topography is rough and mountainous. Elevations range from 500 to 3,000 feet. Annual precipitation is 80 to 120 inches, average annual air temperature is 49° F., and the frost-free period is 145 to 200 days. The vegetation is Douglas-fir, hemlock, alder, swordfern, and vine maple. Kilchis soils are associated with Hembre, Klickitat, and Astoria soils.

In a representative profile, the surface layer is dark reddish-brown stony loam about 7 inches thick. The subsoil is very friable, dark reddish-brown very gravelly loam about 7 inches thick. The substratum is reddish-brown very gravelly loam about 5 inches thick. Basalt rock is at a depth of about 19 inches.

Kilchis soils are used for timber, water supply, recreation, and wildlife habitat.

Kilchis and Klickitat soils, 60 to 90 percent slopes (KKG).-This undifferentiated unit consists of soils of the Kilchis and Klickitat series that were too intermingled to be mapped separately. They are in rough mountainous areas. Kilchis soils occupy about 50 to 60 percent of the total acreage, and Klickitat soils occupy about 40 percent. Hembre soils occupy as much as 10 percent of some mapped areas. Kilchis soils are between escarpments or rock outcrops and areas of Klickitat soils. A representative profile of the Klickitat soils is described under the heading "Klickitat series."

Representative profile of Kilchis stony loam about an eighth of a mile South of Camp One, 70 feet below road on west aspect; SE1/4SW1/4NE1/4 sec. 9, T. 2 S., R. 6 W.:

0-1/3 inch to 0, twigs, leaves, needles.

A1-0 to 7 inches, dark reddish-brown (5YR 2/2) stony loam, dark brown (7.5YR 4/2) when dry; moderate, fine, granular structure; very friable; soft, nonsticky, nonplastic; many fine roots; many very fine pores; 40 percent by volume fine, medium, and coarse basalt fragments and stones; strongly acid (pH 5.2) ; clear, wavy boundary. (4 to 8 inches thick)

B2-7 to 14 inches, dark reddish-brown (5YR 3/3) very gravelly loam; reddish brown (5YR 4/3) when dry; weak, fine, granular structure; very friable, soft, nonsticky, nonplastic; common fine roots; many very fine pores; 60 percent by volume fine, medium, and coarse basalt fragments and stones; very strongly acid (pH 5.0) ; clear, wavy boundary. (5 to 9 inches thick)

C-14 to 19 inches, reddish-brown (5YR 4/4) very gravelly loam; reddish brown (5YR 5/3) when dry; weak, fine, granular structure; few fine roots; very friable, soft, nonsticky, nonplastic; many very fine pores; 75 percent by volume fine, medium, and coarse basalt fragments and stones; very strongly acid (pH 4.8) ; abrupt, wavy boundary. (3 to 10 inches thick)

IIR-19 inches, fractured basalt rock.

The A horizon has values of 2 or 3 when moist and 4 or 5 when dry; chromas are 2 or 3. The B horizon has lines of 5YR or 7.5YR. The B2 horizon and horizons below are more than 50 percent coarse fragments.

Included with. these soils in mapping are areas of Hembre soils less than 5 acres in size that occupy less than 10 percent of the total acreage.

The Kilchis soil has moderately rapid permeability. Roots can penetrate to bedrock, which is at depths of 12 to 20 inches. The available water capacity is less than 3 inches. Runoff is rapid in cleared areas, and the erosion hazard is severe. Fertility is low.

These soils are used mainly for timber. Douglas-fir is the most important tree species. Management is very difficult. Capability unit VIIs-1; woodland group 4f1; wildlife group 5.

Klickitat Series

The Klickitat series consists of well-drained soils that formed over basalt rock in the Coast Range. Slopes range from 5 to 90 percent and are convex. The topography is rough and mountainous. Depth to basalt rock is 40 to 50 inches. Elevation ranges from 500 to 3,000 feet. Annual precipitation is 80 to 120 inches, average annual air temperature is 49° F., and the frost-free period is 145 to 200 days. The vegetation is Douglas-fir, hemlock, alder, swordfern, and vine maple. Klickitat soils are associated with Kilchis, Hembre, and Astoria soils.

In a representative profile, the surface layer is dark reddish-brown stony loam about 7 inches thick. The subsoil is dark reddish-brown, friable very gravelly clay loam about 28 inches thick. The substratum is dark reddish-brown very gravelly clay loam. Basalt bedrock is at a depth of about 45 inches.

Klickitat soils are used for timber, water supply, recreation, and wildlife habitat.

Klickitat stony loam, 5 to 30 percent slopes (KLE).This rolling soil is on ridgetops and side slopes in the Coast Range.

Representative profile about 50 feet west of road, south of borrow pit; NE1/4SE1/4NE1/4 sec. 5, T. 2 S., R. 6 W.:

A1-0 to 7 inches, dark reddish-brown (5YR 3/2) stony loam, dark brown (7.5YR 4/2) when dry; strong, fine, granular structure; very friable, soft, slightly sticky, nonplastic; many fine roots; many fine pores; 40 percent fine concretions and basalt fragments, mainly pebbles and a few stones; strongly acid (pH 5.4) ; clear, smooth boundary. (6 to 12 inches thick)

B21-7 to 18 inches, dark reddish-brown (5YR 3/3) very gravelly light clay loam, dark brown (7.5YR 4/3) when dry; strong, fine, granular structure; friable, soft. slightly sticky, slightly plastic; common fine roots; many fine pores; 60 percent fine concretions and basalt fragments, pebbles, and stones; very strongly acid (pH 5.0) ; clear, smooth boundary. (5 to 12 inches thick)

B22-18 to 35 inches, dark reddish-brown (5YR 3/4) very gravelly clay loam, yellowish red (5YR 5/6) when dry; moderate, fine, granular and subangular blocky structure; friable, soft, slightly sticky, slightly plastic; few fine roots; many fine pores; 70 percent fine concretions and basalt fragments, pebbles, and stones; very strongly acid (pH 5.0) ; gradual, smooth boundary. (9 to 18 inches thick)

C-35 to 45 inches, dark reddish-brown (5YR 3/4) very gravelly clay loam, yellowish red (5YR 5/6) when dry : moderate, fine, subangular blocky structure; friable, soft, slightly sticky, slightly plastic; few roots; common fine pores; 70 to 80 percent fine concretions and basalt pebbles and stones; very strongly acid (pH 4.8) ; gradual, wavy boundary. (10 to 20 inches thick)

IIR-45 inches, broken basalt that has soil material between fractures.

The A horizon has moist chromas of 2 and 3and dry chromas of 3 and 4. The B2 horizon is more than 50 percent coarse fragments.

Included with this soil in mapping are Kilchis, Hembre, and more steeply sloping Klickitat soils in areas as much as 10 acres in size; Astoria soils in areas less than 5 acres in size; and rock outcrops in areas less than an acre in size. These included areas occupy less than 15 percent of the total acreage.

This Klickitat soil has moderate permeability. Roots can penetrate to depths of 40 to 50 inches. The available water capacity is 2 to 4 inches. Organic-matter content is low, and fertility is low. Runoff is medium in cleared areas, and the erosion hazard is moderate.

This soil is used mainly for timber. Douglas-fir and hemlock are the important trees in the cooler, more moist areas. Management can be intensive. Capability unit VIs-1; woodland group 3f1; wildlife group 5.

Klickitat stony loam, 30 to 60 percent slopes (KLF).This soil is in the Coast Range. Runoff is rapid in cleared areas, and the erosion hazard is severe. Douglas-fir and hemlock are the important trees. Management is moderately difficult. Capability unit VIs-1; woodland group 3f2; wildlife group 5.

Klickitat rocky loam, 60 to 90 percent slopes (KRG).This soil is in rough mountainous areas of the Coast Range. Rock crops out in 5 percent of the acreage.

Kilchis soils and Stony land are the major inclusions in this mapping unit. The Kilchis soils occupy 20 percent of the acreage. Stony land occupies 15 percent of this mapping unit and is mostly adjacent to the rock outcrops.

Douglas-fir and hemlock are the major trees. Runoff is rapid where the soil is cleared, and the erosion hazard is very severe. Management is very difficult. Capability unit VIIs-1; woodland group 4fl; wildlife group 5.

Knappa Series

The Knappa series consists of well-drained soils that formed in old alluvium on low terraces in Coast Range valleys. These soils are nearly level to gently undulating and more than 60 inches deep to bedrock. Elevations range from 50 to 300 feet. Annual precipitation is 60 to 70 inches, average annual air temperature is 49° F., and the frost-free period is 165 to 210 days. In areas that are not cultivated, the vegetation is Douglas-fir, alder, and vine maple. On terraces and low hills, the Knappa soils are associated with soils of the Steiwer series, acid variant, with Grande Ronde soils, and with soils of the Hazelair series, acid variant. On uplands they are associated with Ead and Astoria soils.

In a representative profile, the surface layer is very dark grayish-brown silty clay loam about 8 inches thick. The subsoil is firm dark-brown and dark yellowish-brown silty clay loam about 37 inches thick. The underlying material is dark yellowish-brown sandy clay loam that extends to a depth of more than 60 inches.

Knappa soils are used mainly for small grain, hay, and pasture. They are also used for wildlife habitat, recreation, homesites, and water supply.

Knappa silty clay loam, 0 to 7 percent slopes (KnB).This nearly level and gently undulating soil is on terraces near Grand Ronde.

Representative profile about an eighth of a mile west of the Grand Ronde Agency Store, about 75 feet south of State Highway 14; NE1/4NW1/4SW1/4 sec. 1, T. 6 S., R. 8 W.:

Ap-0 to 8 inches, very dark grayish-brown (10YR 3/2) silty clay loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; friable, hard, slightly sticky and slightly plastic; many fine roots; many fine pores: strongly acid (pH 5.3) ; abrupt, smooth boundary. (5 to 8 inches thick)

B1-8 to 21 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; firm, hard, slightly sticky

and plastic; common fine roots; many fine pores; strongly acid (pH 5.2) ; clear, smooth boundary. (8 to 15 inches thick)

B2-21 to 35 inches, dark yellowish-brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/4) when dry; moderate, fine, subangular blocky structure; firm; hard, sticky and plastic; many fine pores; few fine roots; very strongly acid (pH 4.8) ; clear, smooth boundary. (12 to 40 inches thick)

B3-35 to 45 inches, dark yellowish-brown (10YR 4/4) silty clay loam; yellowish brown (10YR 5/4) when dry; moderate, medium, subangular blocky structure; firm, hard, sticky and plastic; many fine pores; few roots; few, thin, patchy, dark films in some pores; very strongly acid (pH 4.8) ; abrupt, smooth boundary. (10 to 20 inches thick)

IIC-45 to 60 inches, dark yellowish-brown (10YR 4/4) moist sandy clay loam, yellowish brown (10YR 5/4) when dry; massive; very friable, slightly sticky and slightly plastic; many fine pores; few roots; very strongly acid (pH 4.6).

The A horizon has moist values of 2 and 3 and dry values of 3 to 5; chromas are 2 and 3. Hue in the B horizon ranges from 10YR to 7.5YR. Structure is moderate to strong. In some places sandy and gravelly substrata are at depths below 40 inches.

Included with this soil in mapping are areas of Hazelair soils, acid variant; Grande Ronde soils; and a well-drained silty soil of recent stream deposition that was not extensive enough to be mapped separately. These included areas are less than 2 acres in size and occupy less than 12 percent of the total acreage.

This soil has moderate permeability. Roots can penetrate to a depth of more than 60 inches. The available water capacity is 11 to 13 inches. Tilth is good, and the soil can be cultivated throughout the year except during storms in winter and spring. Surface runoff is slow. Erosion is a slight hazard in unprotected areas during rainy periods. Fertility is moderate.

Most of the acreage is cultivated. Small grain, hay, and pasture plants are grown. Capability unit IIe-2; woodland group 2o2; wildlife group 1.

Labish Series

The Labish series consists of poorly drained, nearly level clay soils that formed in recent alluvium and peat on lakebeds. Elevation is about 175 feet. Annual precipitation is 42 inches, average annual air temperature is 53° F., and the frost-free period is 165 to 210 days. Labish soils are associated with Cove and Wapato soils.

In a representative profile, the surface layer is black mucky clay that is high in organic-matter content and about 15 inches thick. The next layer is black clay stratified with peat and is about 19 inches thick. It is underlain by raw, woody peat that extends to a depth of 60 inches or more.

Labish soils are used mainly for growing onions.

Labish mucky clay (0 to 1 percent slopes) (Lb).-This level soil is on the Wapato Lake Bed.

Representative profile about 200 feet east of the west dike; 25 feet north of a main east-west drainage ditch, northeast corner of NE1/4NE1/4NE1/4 sec. 2, T. 2 S., R. 4 W.:

Ap-0 to 7 inches, black (10YR 2/1) mucky clay, very dark gray (10YR 3/1) when dry; strong, fine, granular structure; friable, soft, slightly sticky, plastic; many fine roots; many very fine pores; slightly acid (pH 6.2) ; abrupt, smooth boundary. (6 to 11 inches thick)

A1-7 to 15 inches, black (10YR 2/1) mucky clay, dark gray and very dark gray (10YR 3/1 and 4/1) when dry; many, dark yellowish-brown and gray streaks, mottles and nodules; strong, fine, granular structure; friable, hard, slightly sticky, plastic; common fine roots; many very fine pores; medium acid (pH 5.6) ; abrupt, smooth boundary. (7 to 10 inches thick) ,

ACl-15 to 24 inches, black (10YR 2/1) clay, very dark gray (10YR 3/1) when dry; many, fine and medium, light gray and dark yellowish-brown mottles and nodules; weak, medium, prismatic structure; very firm, extremely hard, very sticky, very plastic; few fine roots; few very fine and fine tubular pores; very strongly acid (pH 4.6) ; abrupt, smooth boundary. (7 to 11 inches thick)

AC2-24 to 34 inches, black (10YR 2/1) clay, layered with dark yellowish-brown (10YR 3/4) peat, very dark brown clay and black peat when dry; weak, coarse, prismatic structure; very firm, extremely hard, very sticky, very plastic; few fine roots; few to common fine tubular pores; very strongly acid (pH 4.6)
clear, smooth boundary. (4 to 15 inches thick)

IIOe-34 to 60 inches, raw, woody, dark yellowish-brown (10YR 3/4) peat, black (10YR 2/1) when dry; massive; very strongly acid (pH 4.6).

The A horizon is as much as 24 percent organic matter. The mineral part of the AC horizon has moist values of 2 and 3 and chromas of 0 and 1 in 10YR hue or is neutral. It has a clay texture and is as much as 12 percent organic matter. Depth to raw peat ranges from 26 to 34 inches.

Included with this soil in mapping are areas of Cove soils less than an acre in size that occupy less than 2 percent of the total acreage.

This soil has slow permeability. Root penetration is limited by the level of the water table. The available water capacity is 12 to 16 inches. Tilth is moderate, and this soil is difficult to cultivate during rainy periods. Surface runoff is very slow to ponded, and the hazard of erosion is slight. Fertility is high.

This soil is cultivated. Onions are the major crop. Corn and hay are grown occasionally. The areas of this are encircled by a dike. The water table is controlled during the growing season by a system of wooden drains, open ditches, and a pumping plant. The soil normally is covered with water from late in fall to early in spring. Capability unit IIIw-3; not placed in a woodland group; wildlife group 2.

Laurelwood Series

The Laurelwood series consists of well-drained soils that formed in mixed material on low hills. These soils have slopes of 3 to 60 percent. Elevations range from 300 to 1,200 feet. Annual precipitation is 45 to 50 inches, average annual air temperature is 51° F., and the frost-free period is 165 to 210 days. In areas that are not cultivated, the vegetation is Douglas-fir, bigleaf maple, and Oregon-grape. Laurelwood soils are associated with Nekia and Jory soils.

In a representative profile, the surface layer is dark-brown silt loam about 11 inches thick. The subsoil is firm, dark-brown silty clay loam that is about 35 inches thick. It is underlain by very firm, dark reddish-brown silty clay that overlies basalt bedrock.

Laurelwood soils are used mainly for orchards, berries, grain, hay, and pasture. They are also used for woodland, water supply, wildlife habitat, recreation, and homesites.

Laurelwood silt loam, 3 to 12 percent slopes (LuC).This soil is on the long, broad ridgetops of the Chehalem Mountains.

Representative profile about 100 feet west of the gravel road; SE1/4SE1/4NE1/4 sec. 31, T. 2 S., R. 2 W.:

A1-0 to 5 inches, dark-brown (7.5YR 3/2) silt loam, brown (10YR 5/3) when dry; strong, fine, granular structure; very friable, soft, nonsticky, slightly plastic; many fine roots; many fine pores; 10 percent fine and medium concretions; medium acid (pH 5.6) ; clear, smooth boundary. (5 to 6 inches thick)

A3-5 to 11 inches, dark-brown (7.5YR 3/2) silt loam, brown 10YR 5/3) when dry; moderate, very fine, subangular blocky structure; friable, nonsticky, slightly plastic; many fine roots; many fine and medium pores; 5 percent fine and medium concretions; medium acid (pH 5.6) ; clear, smooth boundary. (5 to 6 inches thick)

Bl-11 to 16 inches, dark-brown (7.5YR 3/4) light silty clay loam, brown (7.5YR 5/4) when dry; moderate, fine and very fine, subangular blocky structure; friable, slightly hard, slightly sticky, plastic; many fine roots; many fine pores; 2 percent medium concretions; few thin clay films; strongly acid (pH 5.4) clear, smooth boundary. (5 to 14 inches thick)

B21t-16 to 22 inches, dark-brown (7.5YR 4/4) silty clay loam, light brown (7.5YR 6/4) when dry; strong, medium and fine, subangular blocky structure; firm, hard, sticky, plastic; many fine roots; many fine pores; common thin clay films; 1 percent fine concretions; strongly acid (p11 5.4) ; clear, smooth boundary. (6 to 13 inches thick)

B22t-22 to 35 inches, dark-brown to strong-brown (7.5YR 4/5) heavy silty clay loam, light brown (7.5YR 6/4) when dry; strong, medium, subangular blocky and blocky structure; firm, hard, sticky, plastic; common fine roots; many fine and medium pores; moderately thick continuous clay films; some black coatings; strongly acid (pI1 5.4) ; clear, smooth boundary. (9 to 18 inches thick)

B3t-35 to 46 inches, dark-brown to strong-brown (7.5YR 3/5) heavy silty clay loam, light brown (7.5YR 6/4) when dry; moderate, fine and very fine, subangular blocky structure; firm, hard, sticky, plastic; few fine roots; common fine pores; moderately thick continuous clay films; common, fine, black coatings; strongly acid (pH 5.4) ; clear, smooth boundary. (7 to 12 inches thick)

IIC-46 to 60 inches, dark reddish-brown (5YR 3/4) silty clay; massive; very firm, very hard, very sticky, very plastic; few fine pores; few moderately thick clay films; few fine fragments of basalt.

The A horizon has moist values and chromas of 2 or 3 and hues of 7.5YR and 10YR. Dry values are 4 and 5, and chromas are 2 and 3. The B horizon has chromas of 4 to 6 and hues 7.5YR and 10YR. Dry chromas are 4 to 6. Texture of the 11C horizon above bedrock ranges from silty clay to clay. Depth to bedrock is more than 40 inches.

Included with this soil in mapping are areas of Nekia and Jory soils. These areas are less than an acre in size and occupy less than 5 percent of the total acreage.

This soil has moderate permeability. Roots can penetrate to a depth of more than 40 inches. Tilth is good, and the soil can be cultivated throughout the year, except during stormy periods in winter and spring. The available water capacity is 7.5 to 12 inches. Surface runoff is slow to medium, and erosion is a moderate hazard in unprotected areas during rainy periods. Fertility is moderate.

Most of the acreage is cultivated. Orchard fruit, berries, grain, hay, and pasture plants are important crops. Capability unit IIIe-2; woodland group 2ol; wildlife group 3.

Laurelwood silt loam, 12 to 20 percent slopes (LuD).This soil is similar to Laurelwood silt loam, 3 to 12 percent slopes, except that it has longer slopes. Runoff is medium, and erosion is a severe hazard in unprotected areas during rainy periods. This soil is used for crops similar to those grown on Laurelwood silt loam, 3 to 12 percent slopes, but management of berry crops is more difficult. Capability unit IIIe-2; woodland group 2ol; wildlife group 3.

Laurelwood silt loam, 20 to 30 percent slopes (LuE).This soil is on the sides of drainageways of the Chehalem Mountains.

Included with this soil in mapping are areas of Nekia and Jory soils. These areas are as much as 3 acres in size and occupy as much as 10 percent of some mapped areas.

Runoff is medium, and the erosion hazard is severe in unprotected areas during rainy periods.

This soil is used for the same crops that are grown on Laurel-wood silt loam, 3 to 12 percent slopes, except that berries are not grown. More intensive management practices are, required, including stripcropping, terraces, and diversions. Capability unit IVe-2; woodland group 2ol; wildlife group 3.

Laurelwood silt loam, 3 to 30 percent slopes (LUE).This soil is mostly in the area west of Mt. Richmond and was mapped at medium intensity. It is used mainly for timber. Most of the acreage would be suitable for cultivation if cleared. Woodland can be managed intensively. Capability unit IVe-2; woodland group 2ol; wildlife group 4.

Laurelwood silt loam, 30 to 60 percent slopes (LUF).This soil has a profile similar to that of Laurelwood silt loam, 3 to 12 percent slopes, except that it is on sides of drainageways on the Chehalem Mountains. This soil is mainly in less intensively mapped woodland areas.

Included with this soil in mapping are areas of Nekia and Jory soils. These areas are as much as 3 acres in size and make up as much as 15 percent of some mapped areas.

Runoff is rapid, and the erosion hazard is severe in unprotected areas during rainy periods. Timber is the principal use. Some pasture plants are grown. Management for woodland is moderately difficult. Capability unit VIe-5; woodland group 2r1; wildlife group 4.

McBee Series

The McBee series consists of moderately well drained soils that formed in recent alluvium along the larger streams. These soils are nearly level to slightly undulating. Elevations range from 30 to 300 feet. Annual precipitation is 40 to 60 inches, average annual air temperature is 53° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is ash, cottonwood, and willow. McBee soils are associated with Chehalis and Wapato soils.

In a representative profile, the surface layer is very dark grayish-brown and dark-brown silty clay loam about 24 inches thick. The subsoil is mottled dark-brown and dark-gray silty clay loam about 22 inches thick. It is underlain by dark-gray silty clay loam that extends to a depth of more than 60 inches.

McBee soils are used mainly for vegetable crops, spring grain, hay, and pasture. They are also used for wildlife habitat and recreation.

McBee silty clay loam (0 to 2 percent slopes) (Mb).This nearly level to slightly undulating soil occupies areas in which overflow water may pond for short periods. Where adjacent to more poorly drained areas, this soil is subject to a fluctuating water table.

Representative profile along the South Yamhill River about 30 feet South of an abandoned county road; NE1/4NW1/4NE1/4 sec. 23, T. 5 S., R. 5 W.:

Ap-0 to 7 inches, very dark grayish-brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) when dry; moderate, fine, subangular blocky structure; friable, hard, slightly sticky, plastic; many fine roots; common very fine pores; slightly acid (pH 6.2) ; abrupt, smooth boundary. (6 to 9 inches thick)

A1-7 to 12 inches, dark-brown (10YR 3/3) silty clay loam, grayish brown (10YR 5/2) when dry; weak, medium, subangular blocky structure; firm, hard, slightly plastic; common fine roots; common very fine and fine pores; medium acid (pH 6.0) ; clear, smooth boundary. (0 to 5 inches thick)

A3-12 to 24 inches, dark-brown (10YR 3/3) silty clay loam, grayish brown (10YR 5/2) when dry; moderate, fine, subangular blocky structure; firm, hard, sticky, plastic; common fine roots; common very fine and fine pores; medium acid (pH 6.0) ; clear, smooth boundary. (9 to 15 inches thick)

B21-24 to 35 inches, dark-brown (10YR 3/3) silty clay loam; brown (10YR 4/3) when dry; many, fine, faint, very dark gray (10YR 3/1) and yellowish-brown (10YR 5/4) mottles; moderate, fine, subangular blocky structure; firm, sticky, plastic; common fine roots; common very fine and fine pores; slightly acid (pH 6.2) ; clear, smooth boundary. (7 to 14 inches thick)

B22-35 to 46 inches, dark-gray (10YR 4/1) silty clay loam, brown (10YR 5/3) when dry; many, fine and medium, distinct, dark-brown (7.5YR 4/4) and yellowish-brown (10YR 5/4) mottles; weak with some moderate, fine, subangular blocky structure; firm, sticky,plastic; common very fine and fine pores; medium acid (pH 6.0) ; clear, wavy boundary. (7 to 13 inches thick)

IIC-46 to 60 inches, dark-gray (10YR 4/1) heavy silty clay; many, fine, distinct, light brownish-gray (10YR 6/2) coatings and mottles, and dark-brown (7.5YR 4/4) mottles; structureless, massive; very firm, very sticky, very plastic; few very fine pores; few, fine, black concretions; medium acid (pH 6.0).

The A horizon is dark colored to a depth of more than 20 inches. Texture of the B horizon ranges from silty clay loam to clay loam. The substratum generally is silty clay or clay, but layers of coarser material occur in places.

Included with this Soil in mapping are areas of Chehalis and Wapato soils. These areas are less than an acre in size and occupy less than 2 percent of the total acreage.

This McBee soil has moderate permeability. Roots can penetrate to a depth of more than 60 inches. The available water capacity is 11 to 13 inches. Tilth is good, but cultivation is restricted during winter and spring storms and during occasional winter overflow. Surface runoff is slow, and erosion is a slight hazard during periods of overflow. Fertility is moderate.

Most, of the acreage is cultivated. Vegetable crops and spring grain are the principal crops. Hay and pasture plants are also grown. Capability unit IIw-5; not placed in a woodland group - wildlife group 1.

Melby Series

The Melby series consists of well-drained soils that formed over sedimentary rock in the Coast Range. Slopes are 3 to 60 percent. Depth to sedimentary rock is 40 to 60 inches. Elevation ranges from 500 to 2,000 feet. Annual precipitation is 60 to 70 inches average annual air temperature is 49° F., and the frost-free period is 145 to 200 days. The vegetation is Douglas-fir, bigleaf maple, alder, and vine maple. Melby soils are associated with Olyic and Peavine soils.

In a representative profile, the surface layer is dark-brown silt loam about 11 inches thick. The subsoil is firm dark-brown and strong-brown silty clay loam and silty clay about 33 inches thick that is underlain by siltstone and shale.

Melby soils are used for timber, water supply, wildlife habitat, and recreation.

Melby silt loam, 3 to 30 percent slopes (MEE).-This gently sloping to steep soil is on smooth ridgetops and side slopes along the eastern part of the Coast Range.

Representative profile about 50 feet west of the junction of Fairchild Creek road and Fairchild bypass road; SW1/4SW1/4SW1/4 sec. 12, T. 2 S., R. 6 W.:

O1-1 inch to 0, twigs, fern fronds, fir needles, moss.

A1-0 to 5 inches, dark-brown (7.5YR 3/2) silt loam, dark yellowish brown (10YR 4/4) when dry; strong, fine, granular structure; friable, soft, slightly sticky, slightly plastic; many fine roots; many fine pores; 20 percent fine soft concretions; strongly acid (pH 5.4) ; abrupt, smooth boundary. (3 to 6 inches thick)

A3-5 to 11 inches, dark-brown (7.5YR 3/4) silt loam, dark yellowish brown (10YR 4/3) when dry; moderate, fine, subangular blocky structure,; friable, slightly hard, slightly sticky, slightly plastic; many fine roots; many very fine pores; 5 percent fine concretions; strongly acid (pH 5.2) ; abrupt, smooth boundary. (4 to 8 inches thick)

Bl-11 to 16 inches, dark-brown (7.5YR 4/4) silty clay loam, yellowish brown (10YR 5/6) when dry; moderate, fine, subangular blocky structure; friable, slightly hard, sticky, slightly plastic; common fine roots; many very fine pores; very strongly acid (pH 5.0) clear, smooth boundary. (3 to 10 inches thick)

B21-16 to 23 inches, strong-brown (7.5YR 4/6) silty clay loam, yellowish brown (10YR 5/6) when dry; moderate, fine, subangular blocky structure; firm, slightly hard, sticky, plastic; few fine roots; many fine pores; very strongly acid (pH .8) ; clear, smooth boundary. (4 to 10 inches thick)

B22-23 to 32 inches, strong-brown (7.5YR 4/6) silty clay, brownish yellow (10YR 6/6) when dry; moderate, fine, subangular blocky structure; firm, hard, sticky, very plastic; few fine roots; many very fine pores, thin clay films on a few peds; few fine fragments of siltstone; very strongly acid (pH 4.6) ; clear, smooth boundary. (6 to 15 inches thick)

B3-32 to 44 inches, strong-brown (7.5YR 5/6 to 5/8) silty clay, brownish yellow (10YR 6/6 and 6/8) when dry; weak, medium and fine, subangular blocky structure; firm, hard, sticky, very plastic; many very fine pores; many fine fragments of siltstone that increase with depth; very strongly acid (pH 4.6) ; gradual, smooth boundary. (6 to 20 inches thick)

R-44 inches, fractured siltstone and shale, light yellowish brown and strong brown (10YR 6/4 and 7.5YR 5/8) wben moist; very strongly acid (pH 4.6).

The Al horizon has moist values of 2 and 3. Dry values are 4 and 5, and lines are 7.5YR and 10YR. Texture ranges from silt loam to silty clay loam. The B2 horizon is domi-

nantly silty clay but ranges from silty clay loam to light clay. A few fine fragments of siltstone are scattered throughout the profile, and normally increase in amount with an increase in depth.

Included with this soil in mapping are areas of Olyic and Peavine soils. These areas are as much as 5 acres in size and occupy 15 percent of the total acreage.

This soil has moderately slow permeability. Roots can penetrate to depths of more than 3 feet. The bedrock generally is soft and pervious to large roots and water. The available water capacity is 7 to 11 inches. Fertility is moderate. Runoff is medium in cleared areas and the erosion hazard is moderate.

This soil is used mainly for timber. Douglas-fir is the major species. Capability unit VIe-2; woodland group 2c2; wildlife group 4.

Melby silt loam, 30 to 60 percent slopes (MEF),-This soil is on the eastern part of the Coast Range. Runoff is rapid in cleared areas, and the erosion hazard is severe. This soil is used for timber. Douglas-fir is the major species. Capability unit VIe-3; woodland group 2c3; wildlife group 4.

Nekia Series

The Nekia series consists of well-drained soils that formed over basalt rock on low hills. Slopes are 2 to 20 percent. Depth to basalt is 20 to 40 inches. Elevations range from 250 to 1,200 feet. Annual precipitation is 40 to 60 inches, the average annual air temperature is 52° to 54° F., and the frost-free period is 165 to 210 days. In areas that are not cultivated, the vegetation is Douglas--fir, oak, poison-oak, and grass. Nekia soils are associated with Jory, Yamhill, Peavine, and Willakenzie soils.

In a representative profile, the surface layer is dark reddish-brown clay loam about 7 inches thick. The upper part of the subsoil is dark reddish-brown silty clay loam about 9 inches thick. The lower part of the subsoil is dark reddish-brown silty clay and clay about 17 inches thick. The substratum is dark reddish-brown silty clay loam. Depth to fractured basalt is about 36 inches.

Nekia soils are used mainly for orchards, berries, grain, hay, pasture, and timber. They are also used for wildlife habitat, recreation, homesites, and water supply.

Nekia clay loam, 2 to 7 percent slopes (NcB).-This gently sloping soil is on smooth ridgetops and side slopes. Depth to bedrock ranges from 20 to 40 inches but is mostly 20 to 30 inches.

Representative profile on the Dundee Hills, about 400 feet west of junction and 30 feet north of road; NE1/4NE1/4SE1/4 see. 27, T. 3 S., R. 3 W.:

Ap-0 to 7 inches, dark reddish-brown (5YR 3/3) clay loam, reddish brown (5YR 4/3) when dry; moderate, fine, subangular blocky structure; friable, hard, sticky, plastic; many fine roots; many very fine and few fine pores; 5 percent fine concretions; medium acid (pH 6.0) ; abrupt, smooth boundary. (5 to 10 inches thick)

B1-7 to 16 inches, dark reddish-brown (5YR 3/3) silty clay loam, reddish brown (5YR 4/3) when dry; weak, fine, subangular blocky structure; friable, hard, sticky, plastic; common fine roots; many very fine pores; 2 percent fine concretions; medium acid (pH 5.8) ; clear, smooth boundary. (3 to 12 inches thick)

B21-16 to 25 inches, dark reddish-brown (5YR 3/3) silty clay, reddish brown (5YR 4/3) when dry; moderate, fine, subangular blocky structure; friable, hard, sticky, very plastic; few fine roots; common very fine pores; few thin clay films on ped surface and pores; 1 percent fine concretions; medium acid (pH 5.6) ; clear, smooth boundary, (4 to 10 inches thick)

B22t-25 to 33 inches, dark reddish-brown (5YR 3/4) clay, reddish brown (5YR 4/4) when dry; moderate, fine, subangular blocky structure; firm, hard, very sticky, very plastic; few line roots; many very fine pores; few thin clay films on ped surfaces and In pores; few fine black stains; few fine concretions; strongly acid (pH 5.4) ; clear, smooth boundary. (8 to 12 inches thick)

C-33 to 36 inches, dark reddish-brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/4) when dry; weak, fine, subangular blocky structure; firm, hard, sticky, plastic; common very fine pores; 20 percent fine fragments of basalt; few fine black stains; strongly acid (pH 5.4) ; abrupt wavy boundary. (0 to 5 inches thick)

R-36 inches, fractured basalt bedrock; black stains and dark reddish-brown (5YR 3/4) films in fractures.

The A horizon has moist values of 2 and 8 and chromas of 2 and 3. The R horizon has hues of 5YR and 2.5YR. A few basalt pebbles and stones are scattered throughout the profile.

Included with this soil in mapping are areas of Jory, Willakenzie, Yamhill, and more steeply sloping Nekia soils. These areas are less than 2 acres in size and occupy less than 5 percent of the total acreage.

This Nekia soil has moderately slow permeability. Roots can penetrate to the bedrock. The available water capacity is 3 to 7 inches. Tilth is good, and the soil can be cultivated throughout the year except during stormy periods in winter and spring. Surface runoff is slow, and erosion is a slight hazard in unprotected areas during rainy periods. Fertility is moderate.

Most of the acreage is cultivated. Orchard fruit, grain, hay, and pasture plants are the principal crops. Berries and grass for seed are also grown. Capability unit IIIe-4; woodland group 3cl; wildlife group 3.

Nekia clay loam, 7 to 20 percent slopes (NcD).-This soil is used for crops similar to those grown on Nekia clay loam, 2 to 7 percent slopes. Runoff is slow to medium. Erosion is a moderate hazard in unprotected areas during rainy periods. Capability unit IVe-1; woodland group 3cl; wildlife group 3.

Newberg Series

The Newberg series consists of somewhat excessively drained soils that formed in recent alluvium. These slightly undulating soils are on bottom lands along the larger streams. Elevation ranges from 30 to 300 feet. Annual precipitation is 40 to 60 inches, average annual temperature is 53° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is willow, ash, and cottonwood. These soils are associated with Cloquato and Chehalis soils.

In a representative profile, the surface layer is very dark grayish-brown fine sandy loam about 8 inches thick. The next layer is dark-brown sandy loam about 10 inches thick. It is underlain by very dark grayish-brown and dark-brown coarse sandy loam to loamy fine sand that is 42 or more inches thick.

Newberg soils are used mainly for vegetable crops, small grain, hay, and pasture. They are also used for wildlife habitat and recreation.

Newberg fine sandy loam (0 to 3 percent slopes) (NU).-This soil is along the larger streams and is hummocky because of overflow erosion.

Representative profile in an orchard on Grand Island, northeast corner of NE1/4NW1/4NW1/4 sec. 26, T. 5 S., R. 3 W.:

Ap-0 to 8 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) when dry; weak, fine, subangular blocky structure; very friable, soft, nonsticky, nonplastic; common fine roots; many very fine irregular pores; medium acid (pH 6.0) ; abrupt, smooth boundary. (7 to 10 inches thick)

AC-8 to 18 inches, dark-brown (10YR 3/3) sandy loam, brown (10YR 5/3) when dry; weak, very fine, subangular blocky structure; very friable, soft, nonsticky, nonplastic; many very fine irregular pores; common fine and few very fine roots; slightly acid (pH 6.2) ; clear, wavy boundary. (6 to 12 inches thick)

Cl-18 to 28 inches, very dark grayish-brown (10YR, 3/2) coarse sandy loam, brown (10YR 5/3) when dry; massive; very friable, soft, nonsticky, nonplastic; many very fine irregular pores; few fine roots; slightly acid (pH 6.4) ; clear, smooth boundary. (8 to 14 inches thick)

C2-28 to 60 inches, dark-brown (10YR 3/3) loamy fine sand, dark yellowish brown (10YR 4/4) when dry; single grain; loose when moist or dry; many very fine irregular pores; slightly acid (pH 6.4).

Dry values are 4 or 5 to a depth of at least 10 inches. Below 10 inches dry values are 4 to 6; moist values are 3 or 4 and chromas are 2 to 4. Thin, finer textured lenses are in the C horizon. Gravel layers are at depths below 40 inches.

Included with this soil in mapping are areas of Cloquato soils, Newberg soils that have a silty surface layer and riverwash. These included areas are less than 2 acres in size and occupy less than 12 percent of the total acreage.

This soil has moderately rapid permeability. Roots can penetrate to depths of more than 60 inches. The available water capacity is 5 to 7.5 inches. Tilth is good, and the soil can be cultivated any time except during periods of overflow that occur several times during winter. Surface runoff is slow. The erosion hazard is slight to severe. Fertility is moderate.

Vegetable crops, orchard fruit, and small grain are the principal crops. Alfalfa, grass and legumes for seed, hay, and pasture plants are also grown. Mint is grown occasionally. Plant nutrients leach away rapidly because the soil is porous. Capability unit IIw-3; not placed in a woodland group; wildlife group 1.

Newberg silt loam (0 to 3 percent slopes) (Nw).-This soil is farther from the streambanks than Newberg fine sandy loam but is also subject to a few periods of overflow each year. It has a profile similar to that of Newberg fine sandy loam, but the surface layer is silt loam 10 to 14 inches thick. Thin lenses of silt loam are common in the sandy substratum. The available water capacity is 6 to 7.5 inches. The infiltration rate is moderate, and the rate of evaporation is less than that of Newberg fine sandy loam. This soil is more fertile and holds plant nutrients better. The same crops are grown on both soils. Capability unit IIw-1; not placed in a woodland group; wildlife group 1.

Olyic Series

The Olyic series consists of well-drained soils that formed over basalt in the Coast Range. These soils have slopes of 5 to 90 percent and are in rough mountainous areas. Elevations range from 500 to 2,000 feet. Annual precipitation is 60 to 80 inches, average annual air temperature is 49° F., and the frost-free period is 145 to 200 days. The vegetation is Douglas-fir, bigleaf maple, alder, and vine maple. Olyic soils are associated with Melby and Peavine soils.

In a representative profile, the surface layer is dark reddish-brown silt loam about 13 inches thick. The subsoil is firm, dark reddish-brown silty clay loam about 29 inches thick. It is underlain by basalt at a depth of about 42 inches.

Olyic soils are used for timber, water supply, wildlife habitat, and recreation.

Olyic silt loam, 5 to 30 percent slopes (OLE).-This soil is on rolling ridgetops and strongly sloping to steep side slopes in the eastern part of the Coast Range.

Representative profile about 60 feet from the High Heaven Road; NW1/4NE1/4SW1/4 sec. 32, T. 3 S., R. 5 W.:

O-1/4 inch to 0, needles, leaves, twigs.

A1-0 to 8 inches, dark reddish-brown (5YR 2/2) silt loam, dark brown (7.5YR 4/2) when dry; strong, fine, granular structure; friable, soft, slightly sticky, slightly plastic; many fine and medium roots; many fine pores; many fine concretions; medium acid (pH 5.6) ; clear, smooth boundary. (6 to 10 inches thick)

A3-8 to 13 inches, dark reddish-brown (5YR 3/3) silt loam, brown (7.5YR 5/4) when dry; strong, fine, granular structure; friable, soft, slightly sticky, slightly plastic; many fine and few medium roots: many fine pores; common fine concretions; strongly acid (pH 5.4) ; clear, smooth boundary. (4 to 7 inches thick)

B1-13 to 20 inches, dark reddish-brown (5YR 3/4) silty clay loam, brown (7.5YR 5/4) when dry; moderate, fine, subangular blocky structure; friable. slightly hard, sticky, plastic; common fine and few large roots; many very fine pores; few thin clay films in some pores; strongly acid (pH 5.4) ; clear, smooth boundary. (6 to 10 inches thick)

B21t-20 to 33 inches, dark reddish-brown (5YR 3/4) silty clay loam, brown (7.5YR 5/4) when dry; moderate, fine, subangular blocky structure; firm, slightly hard, sticky, plastic; few fine roots; many very fine, and few fine pores; few thin clay films on some ped surfaces and in some pores; few pebbles of basalt; very strongly acid (pH 4.8) ; clear, smooth boundary. (12 to 15 inches thick)

B22t-33 to 42 inches, dark reddish-brown (5YR 3/4) heavy silty clay loam, strong brown (7.5YR 5/6) when dry; weak, fine, subangular blocky structure; firm, hard, sticky, very plastic; few fine roots; common fine pores; few thin clay films on ped surfaces and in pores; few very fine fragments of basalt and few pebbles; very strongly acid (pH 4.8) ; clear, irregular boundary. (8 to 14 inches thick)

R-42 to 50 inches, fractured basalt.

The A horizon has hues of 5YR or 7.5YR. The Bt horizon has moist values of 3 and 4 and chromas of 4 to 6. Only a few stones generally are in the upper 40 inches. Bedrock is hard, fractured basalt.

Included with this soil in mapping are areas of Melby, Peavine, and more steeply sloping Olyic soils. These areas are as much as 5 acres in size and occupy less than 15 percent of the total acreage.

This Olyic soil has moderately slow permeability. Roots can penetrate to depths of more than 4 feet. The available

water capacity is 7.5 to 12 inches. Surface runoff is slow to medium, and the erosion hazard is moderate. Fertility is moderate.

This soil is used mainly for timber. Douglas-fir is the major species. Woodland can be managed intensively. Capability unit VIe-2; woodland group 2o2; wildlife group 4.

Olyic silt loam, 30 to 60 percent slopes (OLF).-This soil is in the eastern part of the Coast Range. Runoff is rapid in cleared areas, and the erosion hazard is severe. Douglas-fir is the important tree species for timber. Management is moderately difficult. Capability unit VIe-3; woodland group 2r2; wildlife group 4.

Olyic silt loam, 60 to 90 percent slopes (OLG).-This soil is in rough mountainous areas of the eastern part of the Coast Range.

Included in mapping are areas on lower slopes where this soil is deeper and more stony than typical. Also included are areas, less than an acre in size, where rocks crop out. These inclusions occupy as much as 20 percent of some mapped areas.

Runoff is rapid in cleared areas, and the erosion hazard is very severe. Douglas-fir is the important tree species. Management is difficult. Capability unit VIIe-1; woodland group 2r3; wildlife group 4.

Panther Series

The Panther series consists of poorly drained soils that formed over sedimentary rock. These soils are on low hills. Slopes are 4 to 20 percent and are concave. The soils have a compact clay subsoil. Elevations range from 200 to 1,200 feet. Annual precipitation is 45 to 60 inches, average annual air temperature is 52° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is oak, rosebush, poison-oak, and sedge. Panther soils are associated with Willakenzie, Peavine, Dupee, and Hazelair soils.

In a representative profile, the surface layer is black to very dark brown silty clay loam about 14 inches thick. The subsoil is mottled dark grayish-brown, very firm clay that grades to mottled olive-brown, very firm clay, and is about 22 inches thick. It is underlain by mottled brown, yellowish-brown, and grayish-brown clay. Siltstone and shale are at a depth of about 44 inches.

Panther soils are used primarily for hay and pasture. They are also used for wildlife habitat and water supply.

Panther silty clay loam, 4 to 20 percent slopes (PaD).This gently sloping to strongly sloping soil is in swales and basil-is oil hills. It formed from siltstone and shale.

Representative profile 10 yards south of the county road, 150 feet west of the junction of a field road and the county road; NE1/4SE1/4SW/4 sec. 36, T. 3 S., R. 5 W.:

Ap-0 to 8 inches, black to very dark brown (10YR 2/1 to 2/2) silty clay loam, dark gray (10YR 4/1) when dry; moderate and strong, very fine and fine, subangular blocky structure; firm, slightly hard, sticky, plastic; many fine roots; many very fine irregular and tubular pores; few fine fragments of shale; medium acid (pH 5.7) ; abrupt, smooth boundary. (5 to 9 inches thick)

A1-8 to 14 inches, very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) when dry; few, fine, dark yellowish-brown (10YR 3/4) mottles; weak, medium, prismatic structure that parts to strong, medium, subangular blocky; firm, hard, sticky, plastic; many fine roots; many fine irregular pores; medium acid (pH 5.7) ; abrupt, smooth boundary. (5 to 9 inches thick)

B21g-14 to 24 inches, dark grayish-brown (2.5Y 4/2) clay, light brownish gray (2.5Y 6/2) when dry; many, fine, distinct, gray and yellowish-brown (5Y 5/1 and 10YR 5/6) mottles; weak, very coarse, prismatic structure that parts to weak, coarse, subangular blocky; very firm, very hard, very sticky, very plastic; common fine roots; many very fine tubular pores; slickensides and pressure faces or films on prism surfaces; 2 percent strongly weathered fine siltstone particles; very strongly acid (pH 4.8) gradual, smooth boundary. (5 to 20 inches thick)

B22g-24 to 36 inches, olive-brown (2.5Y 4/3) clay, light brownish gray (2.5Y 6/2) when dry; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, very coarse, prismatic structure; very firm, very hard, very sticky, very plastic; few fine roots; common very fine tubular pores; some slickensides and pressure faces on prism surfaces; 2 percent strongly weathered fine shale and siltstone particles; very strongly acid (pH 4.5) ; gradual, smooth boundary. (8 to 20 inches thick)

Cg-36 to 44 inches, mottled brown, yellowish-brown, and grayish-brown (10YR 5/3, 5/8, and 5/2) moist clay; massive; very firm, very hard, very sticky, very plastic; few very fine pores; 60 percent strongly weathered siltstone and shale fragments; extremely acid (pH 4.2) ; clear, smooth boundary. (7 to 12 inches thick)

R-44 inches, light brownish-gray (2.5Y 6/2), yellowish-brown (10YR 5/6), and brownish-yellow (10YR 6/6) stratified siltstone and shale; very firm, thin, patchy, dark-brown (7.5YR 4/4) films on some fracture surfaces.

The A horizon has moist values of 2 and 3. Mottles range from none to many, fine, distinct, dark reddish brown or dark yellowish brown in the lower part of the A horizon. The B horizon has moist values of 4 and 5; hue normally is 2.5Y but ranges to 5Y and 10YR. Chromas are 2 or less where hue is 10YR. Mottles are faint to distinct. The structure is medium to very coarse prismatic. The fine rock fragments are strongly weathered and make up I to 5 percent of the upper part of the B horizon to more than 60 percent of the layer just above the bedrock. The B horizon is more than 60 percent clay.

Included with this soil in mapping are areas of similar soils that have a surface layer 18 to 26 inches thick over the clay. These included areas are less than an acre in size and occupy as much as 15 percent of some mapped areas.

This Panther soil has very slow permeability. Roots are restricted by the clay at depths of 10 to 18 inches. The available water capacity above the clay is 2 to 4 inches and for the whole profile is 6.5 to 10 inches. This soil is difficult to cultivate except during the summer months when seepage is at a minimum. Surface runoff is slow to medium. The erosion hazard is slight, but the soil may slide during heavy rains in the wet season. Fertility is low.

Most of the acreage has been cleared. Hay and pasture plants are the important crops. Capability unit VIw-1; not placed in a woodland group; wildlife group 3.

Peavine Series

The Peavine series consists of well-drained soils that formed over sedimentary rock on low hills and foot slopes of the Coast Range. These soils have 2 to 60 percent slopes. Elevations range from 400 to 1,200 feet. Annual

precipitation is 55 to 70 inches, average annual air temp erature is 51° F., and the frost-free period is 165 to 210 days. In areas that are not cultivated, the vegetation is Douglas-fir, bigleaf maple, oak, and poison-oak. Peavine soils are associated with Willakenzie, Melby, Ead, Panther, Nekia, Jory, and Olyic soils.

In a representative profile, the surface layer is very dark brown and dark-brown silty clay loam about 10 inches thick. The subsoil is dark reddish-brown and yellowish-red, firm silty clay about 26 inches thick. It is underlain by fractured strongly weathered shale at a depth of about 36 inches.

Peavine soils are used mainly for orchards, small grains, hay, pasture, and timber. They are also used for water supply, wildlife habitat, recreation, and homesites.

Peavine silty clay loam, 2 to 12 percent slopes (PcC).This gently sloping to strongly sloping soil is on ridgetops, on side slopes of low hills and on foot slopes of the Coast Range. Slopes are commonly more than 5 percent.

Representative profile about 50 yards north on field road from county road along ridgetop in the southeastern corner of Moores Valley; SW1/4SW1/4SE1/4 sec. 10, T. 3 S., R. 5 W.:

A1-0 to 4 inches, very dark brown and dark-brown (7.5YR 2/2 and 7.5YR 3/2) silty clay loam, dark brown (7.5YR 4/2 and 4/3) when dry; moderate, fine, subangular blocky structure; friable, slightly hard, sticky, plastic; many very fine and fine roots; common very fine tubular pores; few fine fragments of shale; medium acid (pH 5.6) ; clear, smooth boundary. (3 to 7 inches thick)

A3-4 to 10 inches, dark-brown (7.5YR 3/2) silty clay loam, brown (7.5YR 4/4) when dry; moderate, fine, subangular blocky structure; firm, hard, sticky, plastic; many very fine and fine roots; many very fine tubular pores; few fine fragments of shale; very strongly acid (pH 5.0) ; clear, wavy boundary. (0 to 8 inches thick)

Blt-10 to 15 inches, dark reddish-brown (5YR 3/4) silty clay, yellowish red (5YR 4/6) when dry; moderate, fine, subangular blocky structure; firm, hard, very sticky, very plastic; many fine and medium roots; few fine tubular pores; few thin clay films on ped surfaces and in pores; very strongly acid (pH 4.6) clear, wavy boundary. (0 to 8 inches thick)

B2t-15 to 26 inches, yellowish-red (5YR 4/6) silty clay, yellowish red (5YR 5/6) when dry; moderate, medium, subangular blocky structure; firm, hard, very sticky, very plastic; many medium roots; many very fine tubular pores; common, thin clay films on ped surfaces and in pores; many very fine fragments of shale; very strongly acid (pH 4.5) ; clear, wavy boundary. (8 to 15 inches thick)

B3t-26 to 36 inches, yellowish-red (5YR 4/6) silty clay, yellowish red (5YR 5/6) when dry; moderate, fine, subangular blocky structure; firm, very hard, very sticky, very plastic; common fine roots; many very fine pores; thin nearly continuous clay films on ped surfaces and in pores; many, very fine and fine, variegated brown and yellow fragments of shale; very strongly acid (pH 4.5) ; gradual, wavy boundary. (4 to 10 inches thick)

C1-36 to 49 inches, light yellowish-brown to brownish-yellow fractured, strongly weathered shale with yellowish-red (5YR 4/6) silty clay loam in fractures, yellowish red (5YR 5/6) when dry; massive; firm, very hard, sticky, plastic; common fine roots in fractures; common very fine pores in soil material; many thin clay films coat the shale; very strongly acid (pH 4.5) ; gradual, wavy boundary. (0 to 20 inches thick)

C2-49 to 64 inches, light yellowish-brown to brownish-yellow fractured strongly weathered shale with light yellowish-brown (10YR 6/4) to brownish-yellow (10YR 6/6) silty clay loam in factures, Yellow (10YR 7/6) when dry; massive; few medium roots in fractures; many, moderately thick, yellowish-red (5YR 4/6) clay films coat the shale; extremely acid (pH 4.3) ; gradual, wavy boundary. (0 to 20 inches thick)

R-64 to 84 inches, light yellowish-brown (10YR 6/4) to brownish-yellow (10YR 6/6) very hard fractured bedrock.

The A horizon has moist chromas and values of 2 and 3. Hue is mainly 7.5YR but in places is 5YR and 10YR. Structure is moderate or strong subangular blocky or granular. The upper part of the Bt horizon has moist chromas of 4 to 6. The lower part has moist values of 4 and 5 and chromas of 6 to 8. Texture of the Bt horizon ranges from silty clay to clay. Structure is fine, medium, and in places coarse, subangular blocky. Fine siltstone and shale fragments are scattered throughout the solum and make up as much as 35 percent of the B3 horizon.

Included with this soil in mapping are areas of Panther, Willakenzie, Jory, Nekia, and more steeply sloping Peavine soils. Included' areas are less than 2 acres in size in cultivated areas and less than 5 acres in woodland areas. They occupy less than 10 percent of the total acreage.

This Peavine soil has moderately slow permeability. Roots can penetrate to bedrock. Tilth is moderate, and the soil can be cultivated most of the year except during winter and early in spring. The available water capacity is 5 to 7 inches. Surface runoff is slow to medium, and erosion is a moderate hazard in unprotected areas during rainy periods. Fertility is moderate.

Less than half the acreage is cultivated. Orchard trees, small grain, hay, and pasture plants are grown. Douglas-fir grows in wooded areas. This soil may slide and slump on the steeper slopes during periods of sustained rain. Capability unit IIIe-2; woodland group 2cl; wildlife group 3.

Peavine silty clay loam, 12 to 20 percent slopes (PcD).Runoff on this soil is medium, and erosion is a severe hazard in unprotected areas during rainy periods. Orchard fruit, small grain, hay, and pasture plants are the major crops. Douglas-fir is grown on the woodland. This soil may slide and slump during periods of sustained rain. Capability unit IIIe-2; woodland group 2cl; wildlife group 3.

Peavine silty clay loam, 20 to 30 percent slopes (PcE).-On this soil runoff is medium and the erosion hazard is severe. Orchard fruit, small grain, hay and pasture plants are the main crops. Douglas-fir is grown on the woodland. This soil may slide and slump during periods of sustained rain. More intensive management practices, such as stripcropping and establishing terraces and diversions, are required. Capability unit IVe-2; woodland group 2cl; wildlife group 3.

Peavine silty clay loam, 2 to 30 percent slopes (PCE).This soil was mapped at medium intensity. It is used mainly for timber. Douglas-fir is the important tree species. Most of the acreage would be suitable for cultivation if cleared. Woodland can be managed intensively. Capability unit IVe-2; woodland group 2cl; wildlife group 4.

Peavine silty clay loam, 30 to 60 percent slopes (PCF).-This soil was mapped at medium intensity. Runoff is rapid in cleared areas, and the erosion hazard is severe.

Douglas-fir is the principal crop, but some pasture plants are also grown. This soil may slide and slump during periods of sustained rain. Management is moderately difficult. Capability unit VIe-5; woodland group 2rl; wildlife group 4.

Peavine silty clay loam, moderately shallow, 2 to 7 percent slopes (PeB).-This soil has a profile similar to that of Peavine silty clay loam, 2 to 12 percent slopes, except that depth to sedimentary rock is 20 to 30 inches. The available water capacity is 3 to 5 inches. Surface runoff is slow, and the erosion hazard is moderate in unprotected areas during rainy periods.

Small grain, hay, and pasture plants are the major crops. Douglas-fir is grown on the woodland. Capability unit IIIe-4; woodland group 2cl; wildlife group 3.

Peavine silty clay loam, moderately shallow, 7 to 20 percent slopes (PeD).-This soil is strongly sloping to moderately steep. The available water capacity is 3 to 5 inches. Surface runoff is slow to medium, and the erosion hazard is severe in uprotected areas during rainy periods.

Small grain, hay, and pasture plants are the major crops. Douglas-fir is grown on the woodland. Capability unit IVe-1; woodland group 2cl; wildlife group 3.

Shale Rock Land

Shale rock land (SH) is 50 to 75 percent rock outcrops. The rest is well-drained soils that are too variable to identify and map separately. The soils are less than 20 inches deep over siltstone, sandstone, and shale. They are strongly sloping to very steep. In areas that are not cultivated, the vegetation is oak, poison-oak, grasses, and some Douglas-fir.

The soils are loam to clay in texture and contain few to many sedimentary rock fragments. In some cultivated fields, these soils are very severely eroded. Moist hues are 5YR to 10YR, and values and chromas are 2 through 4.

Included in mapping are areas of soils that are deeper than 20 inches. These included areas are less than an acre in size and occupy less than 10 percent of the total acreage.

The soils of this mapping unit have moderate to slow permeability. Roots penetrate to a depth of 20 inches. Tilth is poor to moderate. The available water capacity is 2 to 5 inches. Surface runoff is medium to rapid, and erosion is a severe hazard in unprotected areas during heavy rains. Fertility is low.

Less than a third of the acreage is cultivated. Hay and pasture plants are the principal crops. Small grain can be grown where slopes are favorable and rock outcrops are of limited extent. Uncultivated areas are in natural oak-grass and pasture. Capability unit VIe-4; not placed in a woodland group; wildlife group 6.

Steiwer Series

The Steiwer series consists of well-drained soils that formed from old alluvium and colluvium. These soils have 5 to 50 percent slopes. Depth to bedrock is 20 to 40 inches. Elevations range from 250 to 650 feet. Annual precipitation is 40 to 50 inches, average annual air temperature is 53° F., and the frost-free period is 165 to 210 days. In areas that are not cultivated, the vegetation is grasses, oak, and poison-oak. Steiwer soils are associated with moderately fine textured Willakenzie, Hazelair, and Yamhill soils and Shale rock land.

In a representative profile, the surface layer is dark-brown silty clay loam about 6 inches thick. The subsoil is clay loam that is dark brown in the upper part, dark yellowish brown in lower part, and about 21 inches thick. Shale that has sandstone lenses is at a depth of about 27 inches.

Steiwer soils are used primarily for grain, hay, and pasture. They are also used for wildlife habitat, recreation, water supply, and homesites.

Steiwer silty clay loam, 5 to 20 percent slopes (StD).This soil is on low hills.

Representative profile in a pasture northeast of Sheridan, 1,000 feet east and 540 feet north of the Sheridan City dump; NW1/4SW1/4SW1/4 sec. 25, T. 5 S., R. 6 W.:

Ap-0 to 6 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure that parts to moderate, fine, granular; firm, hard, sticky, plastic; many very fine roots; common very fine tubular and irregular pores; few, very fine, weathered fragments of shale; strongly acid (pH 5.4) ; abrupt, smooth boundary. (4 to 8 inches thick)

B1-6 to 10 inches, dark-brown (10YR 3/3) clay loam, brown (10YR 5/3) when dry; moderate, very fine, subangular blocky structure; friable, hard, sticky, plastic; many very fine roots; many very fine tubular pores; many, very fine, weathered fragments of shale; strongly acid (pH 5.3) ; clear, wavy boundary. (3 to 8 inches thick)

B21-10 to 19 inches, dark-brown (10YR 3/3) clay loam, brown (10YR 5/3) when dry; moderate, very fine, subangular blocky structure; friable, hard, sticky, plastic; common fine roots; many fine and very fine pores; few, fine strongly weathered fragments of shale; strongly acid (pH 5.3) ; gradual, wavy boundary. (6 to 15 inches thick)

B22-19 to 27 inches, dark yellowish-brown (10YR 3/4) clay loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; firm, hard, sticky, plastic; few fine roots; many very fine pores; 15 percent very fine strongly weathered fragments of shale; strongly acid (pH 5.2) ; abrupt, irregular boundary. (6 to 12 inches thick)

IIC-27 inches, strong-brown (7.5YR 5/6) to reddish-yellow (7.5YR 6/6) variegated shale that has sandstone lenses; reddish-brown clay coatings in the fractures; very strongly acid (pH 4.9).

The A horizon ranges in texture from silt loam to siltyclay loam or clay loam. Moist values are 2 and 3, and chromas are 2 or 3. The B2 horizon is silty clay loam or clay loam. Moist values are 3 or 4, and dry values are 5 or 6; chromas are 3 or 4. Hues range from 10YR to 7.5YR. Content of siltstone and shale fragments ranges from a few in the upper part of the solum to as much as 30 percent in the lower part. These fragments are weathered to some degree. Depth to bedrock ranges from 20 to 40 inches, but is commonly 24 to 32 inches.

Included with this soil in mapping are areas of Yamhill and Willakenzie soils, more steeply sloping Steiwer soils, and Shale rock land. Also included are areas that contain a few scattered stones, and areas of Stony land. The included areas are less than 2 acres in size and occupy as much as 10 percent of some mapped areas.

This soil has moderately slow permeability. Roots can penetrate to depths of 20 to 40 inches. The available water capacity is 3.5 to 8 inches. Surface runoff is medium, and the erosion hazard is severe in unprotected areas during rainy periods. Fertility is low.

Less than half the acreage is cultivated. Grain, hay, and pasture plants are the principal crops. A few prune orchards are in production. Oak-grassland pasture is the principal use. Capability unit IVe-1; not placed in a woodland group; wildlife group 3.

Steiwer silty clay loam, 20 to 30 percent slopes (StE).On this soil, runoff is medium and the erosion hazard is severe in unprotected areas during rainy periods. Oak-grassland pasture is the principal use. Capability unit VIe-1; not placed in a woodland group; wildlife group 4.

Steiwer silty clay loam, 30 to 50 percent slopes (StF).-This soil is similar to Steiwer silty clay loam, 5 to 20 percent slopes, except that inclusions of other soils occupy as much as 15 percent of the soil areas. Runoff is rapid, and the erosion hazard is severe. Oak-grassland pasture is the principal use. Capability unit VIe-5; not placed in a woodland group; wildlife group 4.

Steiwer silty clay loam, basalt substratum, 5 to 20 percent slopes (SuD).-This soil is similar to Steiwer silty clay loam, 5 to 20 percent slopes, except that it does not contain siltstone or shale fragments and is underlain by hard igneous rock instead of soft siltstone and shale. The same crops are grown. The hard, underlying rock is a limitation for road building and other types of construction, but it is more stable than the softer siltstone and shale that underlie the typical Steiwer soil. Capability unit IVe-1; not placed in a woodland group; wildlife group 3.

Steiwer silty clay loam, basalt substratum, 20 to 30 percent slopes (SuE).-This soil is similar to Steiwer silty clay loam, 5 to 20 percent slopes, except that it lacks siltstone or shale fragments and is underlain by hard igneous rock. Runoff is medium, and the erosion hazard is severe in unprotected areas during rainy periods. Oak-grassland pasture is the principal use. Capability unit VIe-1; not placed in a woodland group; wildlife group 4.

Steiwer Series, Acid Variant

Acid variants of the Steiwer series are well-drained soils on high terraces in Coast Range valleys. These soils tire gently sloping to moderately steep and 20 to 40 inches deep over sedimentary rock. Elevations range from 300 to 400 feet. Annual precipitation is about 60 inches, average annual air temperature is 49° F., and the frost-free period is 165 to 210 days. In areas that are not cultivated, the vegetation is oak, Douglas-fir, and grasses. These soils are adjacent to Grande Ronde soils on terraces and Peavine and Ead soils on uplands.

In a representative profile, the surface layer is dark-brown silt loam about 8 inches thick. The subsoil is dark yellowish-brown heavy silt loam about 27 inches thick. It is underlain by siltstone and sandstone at a depth of about 35 inches.

These soils are used for grass seed, hay, and pasture.

Steiwer silt loam, acid variant, 3 to 20 percent slopes (SvD).-Representative profile on a high terrace about a quarter mile east of the Grande Ronde, Agency Store, 20 feet north of State Highway 22, along driveway; SE1/4SE1/4NE1/4 sec. 1, T. 6 S., R. 8 W.:

Ap-0 to 8 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; moderate, fine and very fine subangular blocky and granular structure; friable: soft, slightly sticky, slightly plastic; many fine irregular pores; many fine roots; slightly smeary; very strongly acid (pH 4.8) ; abrupt, smooth boundary. (4 to 8 inches thick)

B1-8 to 16 inches, dark yellowish-brown (10YR 3/4) silt loam, yellowish brown (10YR 5/4) when dry; weak, coarse, subangular blocky structure that parts to weak, very fine, granular; friable, slightly hard, slightly sticky, slightly plastic; many very fine irregular pores; many fine roots; smeary; very strongly acid (pH 4.6) ; clear, smooth boundary. (3 to 8 inches thick)

B2-16 to 27 inches, dark yellowish-brown (10YR 4/4) heavy silt loam, yellowish brown (10YR 5/4) when dry; weak, coarse, subangular blocky structure that parts to weak, very fine, granular; friable, hard, slightly sticky, slightly plastic; many fine and very fine and few medium irregular pores; many fine roots; smeary; very strongly acid (pH 4.6) ; clear, smooth boundary. (6 to 15 inches thick)

B3-27 to 35 inches, yellowish-brown (10YR 5/6) heavy silt loam, light yellowish brown (10YR 6/4) when dry; moderate, very fine, subangular blocky structure; friable, hard, slightly sticky, plastic; many fine irregular pores; slightly smeary; 5 percent fragments of fine sandstone and siltstone; very strongly acid (pH 4.6) ; abrupt, wavy boundary. (6 to 12 inches thick)

IIC-35 inches, yellowish-brown stratified and fractured sandstone and siltstone that can be dug with a spade.

Fine siltstone fragments are scattered in the B horizon and make up as much as 30 percent of the B3 horizon. The underlying sedimentary rock is either siltstone or sandstone,or a stratified mixture of both.

Included with this soil in mapping are the areas of Peavine soils. These areas are less than an acre in size and make up less than 5 percent of the total acreage.

This soil has moderate permeability. Roots can penetrate to depths of 20 to 40 inches. The available water capacity is 3.5 to 8 inches. Tilth is good, and the soil can be cultivated throughout the year except during stormy periods in winter and spring. Surface runoff is medium, and erosion is a severe hazard in unprotected areas during rainy periods. Fertility is low.

Most of the acreage is cultivated. Grass for seed, hay, and pasture plants are the principal crops. Spring grain also is grown. Capability unit IVe-1; not placed in a woodland group; wildlife group 3.

Stony Land

Stony land (SL) consists of well-drained soils that are shallow and very shallow over igneous rock (fig. 10). These soils are too variable to map separately. They are less than 20 inches deep over bard basalt rock and are commonly very stony. They are on gently sloping hilltops and very steep sides of drainageways. The vegetation is grasses, poison-oak, oak, and Douglas-fir.

A few of these soils are stone free, but most of them contain a few to more than 60 percent angular basalt pebbles and stones, and a few boulders. These soils have moist hues of 7.5YR and 5YR and values and chromas of 2 through 4.

Included in mapping are areas of rock outcrop. Also included are very stony soils more than 20 inches deep over hard rock.

Permeability is moderate. Roots penetrate to a depth of 20 inches. The available water capacity is less than 3 inches. Surface runoff is slow to medium, and erosion

Figure 10-Cut in a typical area of Stony land showing the fractured basalt that is beginning to weather.

is a moderate to severe hazare in unprotected areas during rainy periods. Fertility is low, and acidity is medium.

Stony land is too shallow, and stony to be cultivated. Pasture is the principal use. Capability unit VIs-1; not placed in a woodland group; wildlife group 6.

Terrace Escarpments

Terrace escarpments (Te) are along small streams that have cut deeply into the Willamette Valley terraces, and where the terraces meet the bottom lands and flood plains along the major streams and rivers. The short, smooth slopes range from 20 to 40 percent. The soil material is silty and sandy and is stratified. It is too variable to be classified as a soil series.

In a representative profile, the surface layer is thin, dark-brown silt loam over a firm, yellowish-brown silt loam substratum.

This land type is well drained but in places includes small seep spots and "wet-weather springs." Slumps and landslides occur during long periods of rain (fig. 11).

Most of the acreage is still in brush, ash, oak, and Douglas-fir. Some areas have been cleared for pasture. The hazard of erosion is severe where this land is unprotected.

This land is well suited to wildlife use. It is poorly suited to homesites because of the unstable soil eonditions. Capability unit VIe-1; not placed in a woodland group; wildlife group 4.

Wapato Series

The Wapato series consists of poorly drained soils that formed in recent alluvium. These soils are on bottom land along small streams and in low-lying areas along the larger streams. The topography is smooth and

Figure 11-Landslide that occurred in an area of Terrace escarpments during a storm in winter.

nearly level or basinlike. Elevations range from 100 to 300 feet. Annual precipitation is 40 to 45 inches, average annual air temperature is 53° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is ash, willow, sedges, and grass. These soils are associated with Cove, Chehalis, and McBee soils.

In a representative profile, the surface layer is mottled very dark grayish-brown silty clay loam about 16 inches thick. The upper part of the subsoil is distinctly mottled dark grayish-brown to grayish-brown silty clay loam about 16 inches thick. The lower part of the subsoil is mottled grayish-brown silty clay.

Wapato soils are used for late planted vegetable crops, small grain, grass and legumes for seed, hay, pasture plants, and wildlife habitat.

Wapato silty clay loam (0 to 3 percent slopes) (Wc).This soil is in low-lying areas along streams. It has smooth topography and is subject to short periods of overflow and ponding.

Representative profile in a field of vetch along the South Yamhill River, 50 feet south of abandoned county road; NW1/4NW1/4NE1/4 sec. 23, T. 5 S., R. 5 W.:

Ap-0 to 9 inches, very dark grayish-brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) when dry; very dark brown (10YR 2/2) coatings on peds;weak and moderate, fine, subangular blocky structure; firm, slightly hard, slightly sticky, plastic; many very fine pores; many fine roots; slightly acid (pH 6.4)abrupt, smooth boundary. (6 to 9 inches thick)

A1-9 to 16 inches, very dark grayish-brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) when dry; very dark brown coatings on ped surfaces; many, fine, distinct, dark reddish-brown (5YR 3/2) mottles; few, fine, black stains and coatings; moderate, fine, subangular blocky structure; friable, hard, slightly sticky, plastic; many very fine and common fine pores; common fine roots; slightly acid (pH 6.2) ; gradual, smooth boundary. (6 to 10 inches thick)

B21g-16 to 22 inches, dark grayish-brown (10YR 4/2) silty clay loam, grayish brown (10YR 5/2) when dry; many, fine, distinct, dark reddish-brown (5YR 3/2) mottles; few, fine, black stains; moderate, medium and fine, subangular blocky structure; friable, hard, sticky, plastic; many very fine and few fine pores; few fine roots; medium acid (pH 5.8) ; clear, smooth boundary. (5 to 8 inches thick)

B22g-22 to 32 inches, dark grayish-brown to grayish-brown (10YR 4/2-5/2) silty clay loam; many, fine, distinct, dark reddish-brown (5YR 4/4) mottles; common, fine, black stains; moderate, medium, fine, subangular blocky structure; firm, hard, sticky, plastic; many very fine and few fine pores; medium acid (pH 5.8)
clear, smooth boundary. (9 to 22 inches thick)

B3g-32 to 60 inches, grayish-brown (10YR 5/2) silty clay, light gray (10YR 7/2) when dry; many, fine, distinct, dark-brown (7.5YR 4/4) mottles; common, medium and fine, black stains; weak, subangular blocky structure; firm, very sticky, plastic; few fine pores; medium acid (pH 5.6).

The A horizon has moist values of 2 and 3, dry values of 4 or 5, and chromas of 2 or 3. In places, distinct mottles occur throughout the A horizon or only in the lower part. The A horizon is dominantly silty clay loam but is silt loam in places. The B2 horizon has moist values of 4 and 5 and chromas of 1 and 2; hue is 10YR to 2.5Y, and in places it is 5Y. Mottles are distinct to prominent. Texture is dominantly silty clay loam, but ranges to a silty clay in the lower part below a depth of 30 inches. A few waterworn pebbles are embedded in the solum. In places the solum is underlain by stratified layers that contain pebbles and stones below a depth of 40 inches.

Included with this soil in mapping are areas of Cove and Chehalis soils, narrow, steeper sided drainageways, and in the Sheridan area, some unnamed gravelly soils. These included areas are as much as an acre in size and make up less than 5 percent of the total acreage.

This Wapato soil is moderately slowly permeable to roots and water. During winter and early in spring, a temporary water table restricts root growth. The available water capacity is 10 to 12 inches. Tilth is moderately good, but seedbed preparation can be difficult if the soil is worked when too wet or too dry. Surface runoff is slow, and water ponds for short periods during winter. The erosion hazard is slight. This soil is subject to occasional to frequent overflow. Fertility is moderate.

Most of the acreage has been cleared for cultivation. Small grain, hay, and pasture plants are the principal crops. Corn, other late-planted vegetable crops, and grass and legumes for seed are also important. Drainage either by open ditches or tile is needed in order to lower the water table in spring. Because of the low-lying position of the soil, drainage outlets are often difficult to establish. Capability unit IIIw-5; not placed in a woodland group; wildlife group 2.

Willakenzie Series

The Willakenzie series consists of well-drained soils that are 20 to 40 inches deep over sedimentary rock. These soils are on low hills and have slopes of 2 to 45 percent. Elevations range from 250 to 800 feet. Annual precipitation is 40 to 50 inches, average annual air temperature is 53° F., and the frost-free period is 165 to 210 days. In areas that are not cultivated, the vegetation is oak, poison-oak, rosebush, and widely spaced Douglas-fir. Willakenzie soils are associated with Dupee, Hazelair, Panther, Nekia, and Carlton soils.

In a representative profile, the surface layer is dark-brown silty clay loam about 4 inches thick. The subsoil is friable to firm, dark-brown silty clay loam about 28 inches thick. The underlying material is yellowish-red loam. Fractured siltstone is at a depth of about 36 inches.

Willakenzie soils are used mainly for orchards, small grain, hay, and pasture. They are also used for timber, wildlife habitat, recreation, homesites, and water supply.

Willakenzie silty clay loam, 2 to 12 percent slopes (WeC).-This soil is on ridgetops and sides of low hills. Slopes are dominantly more than 5 percent. Depth to sedimentary rock is 30 to 40 inches.

Representative profile about 200 feet north of the Carlton-Panther Creek Road and about 600 feet east of road junction along the southern line of SE1/4NW1/4SW1/4 sec. 24, T. 3 S., R. 5 W.:

A1-0 to 4 inches, dark-brown (7.5YR 3/2) silty clay loam, brown (7.5YR 5/3) when dry; weak, medium and fine, subangular blocky structure; friable, hard, slightly sticky, slightly plastic; many very fine pores; many fine roots; very few fine concretions; medium acid (pH 6.0) ; clear, smooth boundary. (3 to 9 inches thick)

B1-4 to 12 inches, dark-brown (7.5YR 3/4) silty clay loam, strong brown (7.5YR 5/6) when dry; moderate, medium and fine, subangular blocky structure; friable, hard, sticky, plastic; many very fine pores; many fine roots; medium acid (pH 6.0) ; clear, wavy boundary. (7 to 10 inches thick)

B21t-12 to 18 inches, dark-brown (7.5YR 4/4) silty clay loam, strong brown (7.5YR 5/6) when dry; moderate, fine and very fine, subangular blocky structure; friable, hard, sticky, very plastic; common medium and fine pores; many fine roots; few thin clay films in pores and on some ped surfaces; medium acid (pH 6.0) ; clear, smooth boundary. (5 to 8 inches thick)

B22t-18 to 26 inches, dark-brown (7.5YR 4/4) silty clay loam, strong brown (7.5YR 5/6) when dry; weak, medium, subangular blocky that breaks to moderate, fine, subangular blocky structure; firm, hard, very sticky, very plastic; many very fine pores; common fine roots; few very thin clay films on ped surfaces; medium acid (pH 5.6) ; gradual, wavy boundary. (6 to 12 inches thick)

B23t-26 to 32 inches, dark-brown (7.5YR 4/4) silty clay loam, strong brown (7.5YR 5/6) when dry; weak, medium and fine that breaks to moderate, very fine, subangular blocky structure; firm, hard, very sticky, very plastic; many very fine pores; common fine roots; many thin clay films; strongly acid (pH 5.4) abrupt, wavy boundary. (5 to 7 inches thick)

IIC-32 to 36 inches, yellowish-red (5YR 4/6) loam; weak, fine, angular blocky structure; friable, sticky, plastic; few fine pores; few fine roots; common thick clay films on the coarse fragments; 80 percent strongly weathered siltstone fragments; very strongly acid (pH 4.7) ; abrupt, smooth boundary. (3 to 4 inches thick)

IIR-36 inches, hard, fractured siltstone bedrock.

The solum. generally has hue of 7.5, but hue grades from 10YR in the A horizon to 5YR in the lower part of the B horizon. Soils that formed from siltstone have redder hues than soils that formed from sandstone. The A horizon has moist values of 2 and 3 and chromas of 2 or 3. Dry values are 5 or 6. Texture is loam to silty clay loam. The B horizon generally has chromas of 4 when moist, but in places chromas are 6 in the lower part. The B horizon ranges from clay loam to silty clay loam. The lower part of the Bt horizon is heavy silty clay loam or silty clay in some areas. The upper 20 inches of the Bt horizon is 27 to 35 percent clay. Strongly weathered rock fragments are commonly abundant below

depths of 24 to 30 inches, and a few are embedded throughout the solum. where the rock is softer and more weathered.

Included with this soil in mapping are areas of Dupee, Nekia, Peavine, Panther, Hazelair, and more steeply sloping Willakenzie soils. These included areas are less than 2 acres in size and occupy as much as 10 percent of some mapped areas.

This Willakenzie soil has moderately slow permeability. Roots can penetrate to depths of 30 to 40 inches. Tilth is moderate, and the soil can be cultivated most. of the year, except during winter and early in spring. The available water capacity is 5 to 7.5 inches. Surface runoff is slow to medium, and erosion is a moderate hazard in unprotected areas during rainy periods. Fertility is moderate.

Most of the acreage has been cultivated. Orchard fruit, small grain, hay, and pasture, plants are grown. Oak-grass land pasture is the principal use in uncleared areas. Capability unit IIIe-2; woodland group 2cl; wildlife group 3.

Willakenzie silty clay loam, 12 to 20 percent slopes (WeD).-On this soil, runoff is medium and the erosion hazard is severe in unprotected areas during rainy periods. The main crops are orchard fruit, small grain, hay, and pasture plants. Oak-grassland pasture is the principal use in uncleared areas. Capability unit IIIe-2; woodland group 2c1; wildlife group 3.

Willakenzie silty clay loam, 20 to 30 percent slopes (WeE).-This soil contains scattered basalt stones that rolled down from higher areas. Runoff is medium, and the erosion hazard is severe. The main crops are orchard fruit, small grain, hay, and pasture plants. Stripcropping, terraces, diversions, and other intensive management practices are required. Oak-grassland pasture is the principal use in uncleared areas. Douglas-fir also is grown. Capability unit IVe-2; woodland group 2c1; wildlife group 3.

Willakenzie silty clay loam, 30 to 45 percent slopes (WeF).-This soil contains basalt stones. Runoff is rapid in cleared areas, and the erosion hazard is severe. Oak-grassland pasture is the principal use, but Douglas-fir is grown in places. Management is moderately difficult. Capability unit VIe-5; woodland group 2r1; wildlife group 4.

Willakenzie silty clay loam, moderately shallow, 2 to 7 percent slopes (WkB).-This soil has a profile similar to that of Willakenzie silty clay loam, 2 to 12 percent slopes, except that depth to sedimentary rock is 20 to 30 inches. The available water capacity is 3 to 5 inches. Surface runoff is slow, and the erosion hazard is moderate in unprotected areas during rainy periods. This soil contains scattered basalt stones that rolled down from higher areas. Small grain, hay, and pasture plants are the principal crops. Uncultivated areas are in oak-grassland pasture. A few prune orchards are in production. Capability unit IIIe-4; woodland group 2cl; wildlife group 3.

Willakenzie silty clay loam, moderately shallow, 7 to 20 percent slopes (WkD).-This soil has a profile similar to that of Willakenzie silty clay loam, moderately shallow, 2 to 7 percent slopes, except that the rooting depth is 20 to 30 inches. Included in mapping are stony areas. The available water capacity is 3 to 5 inches. Surface runoff is slow to medium, and the erosion hazard is severe in unprotected areas during rainy periods. Small grain, hay, and pasture plants are the principal crops. Uncultivated areas are in oak-grassland pasture. A few prime orchards are in production. Capability unit IVe-1; woodland group 2cl; wildlife group 3.

Willamette Series

The Willamette series consists of well-drained soils that formed in old alluvium. These soils are on low, broad, valley terraces. Slopes are 0 to 20 percent. Elevations range from 150 to 400 feet. Annual precipitation is 40 to 50 inches, average annual air temperature is 53° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is grass, Oregon white oak, and Douglas-fir. Willamette soils are associated with Woodburn, Amity, and Aloha soils.

In a representative profile, the surface layer is dark-brown silt loam about 14 inches thick. The subsoil is dark-brown silt loam and light silty clay loam about 32 inches thick. The substratum is dark-brown silty clay loam that extends to a depth of 60 inches or more.

Willamette soils are used mainly for vegetable crops, berries, orchards, small grain, hay, and pasture. They are also used for wildlife habitat, recreation, and homesites.

Willamette silt loam, 0 to 3 percent slopes (WIA).This soil is in the community of Bellevue and near terrace escarpments.

Representative profile, in an orchard near Bellevue about 50 feet east of State Highway 18, northeast corner of SW1/4NE1/4SW1/4 sec. 29, T. 5 S., 11. 5 W.:

Ap-0 to 6 inches, dark-brown (10YR 3/3) silt loam, grayish brown (10YR 5/2) when dry; weak, medium, subangular blocky structure; friable, slightly hard, slightly sticky, slightly plastic; common fine roots; many very fine tubular pores; trace of very dark brown (10YR 2/2) coatings on pod surfaces; medium acid (pH 5.8) ; abrupt, smooth boundary. (5 to 7 inches thick)

Al-6 to 14 inches, dark-brown (10YR 3/3) silt loam, grayish brown (10YR 5/2) when dry; weak, medium and coarse, subangular blocky structure; firm, slightly hard, slightly sticky, slightly plastic; few fine roots; many very fine tubular pores; trace of very dark grayish-brown (10YR 3/2) coatings on some ped surfaces; medium acid (pH 5.8) ; clear, smooth boundary. (4.8 to 8 inches thick)

Bl-14 to 23 inches, dark-brown (10YR 3/3) heavy silt loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; hard, firm, slightly sticky, plastic; trace of fine roots; many very fine tubular pores; few thin clay films in pores and on a few ped surfaces; few, fine, very dark grayish-brown (10YR 3/2) coatings; medium acid (pH 6.0) ; clear, smooth boundary. (7 to 11 inches thick)

B21t-23 to 35 inches, dark-brown (10YR 3/3) light silty clay loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; firm, hard, sticky, plastic; trace of fine roots; many very fine tubular pores; few thin clay films in pores and on ped surfaces; some fine black stains; medium acid (pH 6.0)
clear, smooth boundary. (10 to 14 inches thick)

B22t-35 to 46 inches, dark-brown (10YR 4/3) light silty clay loam, pale brown (10YR 6/3) when dry; weak to moderate, fine, subangular blocky structure; firm, hard, sticky, plastic; trace of fine roots; many very fine tubular pores; thin continuous clay films in pores; few thin clay films on ped surfaces; slightly

acid (pH 6.2) ; clear, smooth boundary. (6 to 12 inches thick)

C-46 to 60 inches, dark-brown (10YR 4/3) light silty clay loam, pale brown (10YR 6/3) when dry; massive, that parts to weak, coarse, prismatic structure; firm, slightly hard, sticky, plastic; trace of fine roots; many very fine tubular pores; few thin and medium clay films in pores; slightly acid (pH 6.2).

In places the A horizon is very dark brown, dark brown, or very dark grayish brown when moist. The Bt horizon is heavy silt loam to silty clay loam. In places it has weak or moderate, medium prismatic and moderate, subangular blocky structure. The C horizon is silt loam or silty clay loam that has some coarser textured strata. This horizon has a few faint mottles and gray streaks in places.

Included with this soil in mapping are areas of Woodburn, Amity, and more steeply sloping Willamette soils. These included areas are less than an acre in size and occupy less than 5 percent of the total acreage.

This soil is moderately permeable to water, and roots can penetrate to depths of more than 60 inches. The available water capacity is 11 to 13 inches. Tilth is good, and the soil can be cultivated throughout the year, except during winter and spring storms. Surface runoff is slow, and unprotected areas are slightly susceptible to sheet erosion during heavy rains. Fertility is high.

Most of the acreage is cultivated. Orchard fruit, vegetables, berries, alfalfa, and small grain are the most important crops. This soil is also used for hay, pasture, and legumes grown for seed. Capability unit IIe-1; not placed in a woodland group; wildlife group 1.

Willamette silt loam, 3 to 12 percent slopes (WIC).This soil is similar to Willamette silt loam, 0 to 3 percent slopes, except that it has short, gentle and strong slopes along small drainageways. Similar crops are grown. Runoff is slow to medium, and erosion is a slight to moderate hazard in unprotected areas during rainy periods. Capability unit IIe-1; not placed in a woodland group; wildlife group 1.

Willamette silt loam, 12 to 20 percent slopes (WID).This soil is along the large, deep draws. It has a profile similar to that of Willamette silt loam, 0 to 3 percent slopes, but it has short, moderately steep slopes. Runoff is medium, and erosion is a moderate hazard in unprotected areas during rainy periods. Orchards, alfalfa, small grain, legumes for seed, hay, and pasture plants are the most important crops. Berries and vegetable crops also are grown, but management is more difficult than on less steep Willamette soils. Capability unit IIIe-1; not placed in a woodland group; wildlife group 1.

Woodburn Series

The Woodburn series consists of moderately well-drained soils that formed in silty alluvium. These soils are on the Willamette Valley terraces and have slopes of 0 to 20 percent. Elevations range from 150 to 400 feet. Annual precipitation is 40 to 50 inches, average annual air temperature is 53° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is grass, Oregon white oak, and Douglas-fir. Woodburn soils are associated with the well-drained Willamette soils and the somewhat poorly drained Aloha and Amity soils.

In a representative profile, the surface layer is very dark-grayish-brown silt loam about 10 inches thick. The subsoil is distinctly mottled in the lower part and is dark yellowish-brown, dark grayish-brown, and brown, firm heavy silt loam about 48 inches thick. It is underlain by brown silt loam that extends to a depth of more than 65 inches.

Woodburn soils are used mainly for vegetable crops, berries, orchards, small grains, and hay and pasture. They are also used for wildlife habitat, recreation, and homesites.

Woodburn silt loam, 0 to 7 percent slopes (WuB).This is the most extensive soil on the Willamette Valley terraces. Slopes are dominantly 0 to 3 percent.

Representative profile in a field near McMinnville; about 40 feet north of county road; SE1/4SE1/4SW1/4 sec. 15, T. 4 S., R. 4 W.:

Ap-0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; friable, hard, slightly sticky, slightly plastic; many very fine roots; many very fine pores; slightly acid (pH 6.2) ; abrupt, smooth boundary. (6 to 10 inches thick)

A1-7 to 10 inches, very dark grayish-brown (10YR 3/2) silt loam, brown (10YR 5/3) when dry; weak, fine, subangular blocky structure; firm, hard, slightly sticky, slightly plastic; many very fine roots; common very fine and few fine pores; medium acid (pH 6.0) abrupt, smooth boundary. (0 to 8 inches thick)

Bl-10 to 19 inches, very dark grayish-brown (10YR 3/2) heavy silt loam, grayish brown (10YR 5/2) when dry; moderate, fine, subangular blocky structure; firm, hard, slightly sticky, plastic; common fine roots; many fine and very fine pores; few thin clay films; medium acid (pH 6.0) ; clear, smooth boundary. (0 to 10 inches thick)

B21t-19 to 28 inches, dark yellowish-brown (10YR 3/4) heavy silt loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; firm, hard, slightly sticky, plastic; common fine roots; many very fine, common fine and few medium pores; thin continuous clay films on most ped surfaces; few medium and thick clay films in larger pores; medium acid (pH 5.8) ; clear, smooth boundary. (7 to 9 inches thick)

B22t-28 to 38 inches, dark grayish-brown (10YR 4/2) heavy silt loam, grayish brown (10YR 5/2) when dry; few, fine and medium, light-gray coatings outlined in dark reddish brown; few, fine, distinct, dark reddish-brown mottles; weak, medium and coarse, subangular blocky structure; very firm, very hard, slightly sticky, plastic; few fine roots; many very fine and few fine pores; thin, continuous, very dark grayish-brown (10YR 3/2) clay films on ped surfaces and in pores; peds brittle: medium acid (pH 5.8) ; clear, smooth boundary. (6 to 10 inches thick)

B3-38 to 58 inches, brown (10YR 5/3) heavy silt loam, pale brown (10YR 6/3) when dry; few, fine, distinct, dark reddish-brown and gray mottles; weak, coarse, subangular blocky structure; firm, hard, slightly sticky, plastic; few very fine and fine pores; medium and thick clay films in larger pores and on some ped surfaces; medium acid (pH 5.8) ; gradual, smooth boundary. (15 to 27 inches thick)

C-58 to 65 inches, brown (10YR 5/3) silt loam, pale brown (10YR 6/3) when dry; massive; firm, hard, slightly sticky, slightly plastic: common very fine and fine pores; few thin clay films in pores; medium acid (pH 5.8).

The A horizon has moist values of 2 and 3, chromas of 2and 3, and hue of 10YR. Dry values are 4 and 5 and chromas are 2 and 3. Between depths of 10 and 20 inches, moist values and chromas range to 4. Distinct mottles are within a depth of 30 inches. The B2 horizon ranges from heavy silt loam to silly clay loam. Horizons below a depth of 30 inches are firm to very firm and are brittle.

Included with this soil in mapping are areas of Aloha, Amity, Willamette, and Dayton soils and more steeply sloping Woodburn soils. These areas are as much as an acre in size and make up less than 5 percent of the total acreage.

This soil is moderately permeable to water in the upper part and slowly permeable in the lower part. Roots can penetrate to depths of more than 60 inches. The available water capacity is 11 to 13 inches. Fertility is high. Tilth is good, and the soil can be cultivated throughout the year, except during storms in winter and spring. Surface runoff is slow. Erosion is a slight hazard in the nearly level areas during heavy rains and in gently sloping areas near shallow draws during rainy periods.

Most of the acreage is cultivated. Small grain and legume seed are the most important crops. Orchard trees, vegetable crops, berries, alfalfa, and hay and pasture plants are also grown. Capability unit IIw-6; not placed in a woodland group; wildlife group 1.

Woodburn silt loam, 7 to 12 percent slopes (WuC).This soil is similar to Woodburn silt loam, 0 to 7 percent slopes, except that it has short, strong slopes on sides of drainage-ways. Runoff is slow to medium, and erosion is a slight to moderate hazard in unprotected areas during rainy periods. Crops grown are similar to those grown on the more nearly level Woodburn soils. Intensive drainage is required to control seepage from adjacent soils. Included with this soil in mapping are Amity or Dayton soils on the bottom of the draws. Capability unit IIe-4; not placed in a woodland group; wildlife group 1.

Woodburn silt loam, 12 to 20 percent slopes (WuD).This soil is along the large, deep draws. Runoff is medium, and erosion is a moderate hazard in unprotected areas during rainy periods. The soil has seep spots and "wet-weather springs" that require intensive drainage. Included with this soil in mapping was a narrow strip of a somewhat poorly drained Amity soil along the bottom of the draws. Capability unit IIIe-5; not placed in a woodland group; wildlife group 1.

Yamhill Series

The Yamhill series consists of well-drained soils that formed over basalt on low hills. These soils have 2 to 50 percent slopes. Depth to basalt rock is 20 to 40 inches. Elevations range from 260 to 600 feet. Annual precipitation is 40 to 50 inches, average annual air temperature is 52° F., and the frost-free season is 165 to 210 days. In areas that are not cultivated, the vegetation is oak, rosebush, poison-oak, and some Douglas-fir. Yamhill soils are associated with Nekia, Jory, Steiwer, and Willakenzie soils.

In a representative profile, the surface layer is dark-brown silt loam about 7 inches thick. The subsoil is dark-brown friable silty clay loam in the upper 9 inches and dark reddish-brown, firm silty clay and gravelly clay in the lower part. Hard, partly weathered, fractured basalt rock is at a depth of about 39 inches.

Yamhill soils are used mainly for orchards, small grain, hay, and pasture. They are also used for wildlife habitat, recreation, and homesites.

Yamhill silt loam, 2 to 7 percent slopes (YaB).-This soil has gentle slopes. It is 30 to 40 inches deep over bedrock.

Representative profile on a northwest slope 257 feet east of road about 600 feet north of road curve; SW1/4NW1/4NW1/4 sec. 16, T. 5 S., R. 5 W.:

Ap-0 to 7 Inches, dark-brown (7.5YR 3/2) silt loam, brown (7.5YR 5/4) when dry; moderate, fine and very fine, subangular blocky structure; friable, hard, slightly sticky, slightly plastic; many very fine pores; many fine roots; slightly acid (pH 6.2) ; abrupt, smooth boundary. (6 to 8 inches thick)

B1-7 to 16 inches, dark-brown (7.5YR 3/2) silty clay loam, brown (7.5YR 5/4) when dry; moderate, fine, subangular blocky structure; friable, hard, sticky, plastic; many very fine pores; common fine roots; medium acid (pH 6.0) ; clear, smooth boundary. (0 to 11 inches thick)

B21-16 to 24 inches, dark reddish-brown (5YR 3/3) silty clay, reddish brown (5YR 5/4) when dry; strong, medium and fine, subangular blocky structure; firm, very hard, very sticky, plastic; common very fine pores; few fine roots; medium acid (pH 5.8) ; clear, smooth boundary. (5 to 15 inches thick)

B22-24 to 36 inches, dark reddish-brown (5YR 3/3) silty clay, reddish brown (5YR 5/4) when dry; moderate, medium, subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine pores; few fine roots; few fine fragments of basalt; medium acid (pH 6.0) ; clear, smooth boundary. (9 to 14 inches thick)

IIB23t-36 to 39 inches, dark reddish-brown (5YR 3/4) gravelly clay, reddish brown (5YR 5/4) when dry; weak, medium, subangular blocky structure; very firm, very hard, very sticky, very plastic; common, fine pores; common, thin, continuous clay films and few moderately thick clay films on ped surfaces and in pores and channels; 30 percent fine

IIR-39 inches, very hard partly weathered fractured basalt rock; dark-red soil coatings and clay films on fracture surfaces.

The A horizon has 7.5YR hue, but in places hue is 10YR. Moist chromas are 2 and 3. Dry chromas are 3 or 4. The A horizon contains a few fine concretions in places, but generally is free of concretions. Texture is silt loam, but in places it ranges to silty clay loam. The B horizon has hues of 7.5YR to 5YR and is redder in the lower part. Moist chromas range from 2 through 4. Dry values are 4 or 5. In places, a few fine basalt fragments are embedded in the lower part of the B horizon. The IIB2 horizon has color characteristics similar to those of the B2 horizons. It is heavy silty clay or clay in texture, and is 10 to 50 percent fine strongly weathered basalt fragments.

Included with this soil in mapping are areas of Nekia, Jory, Steiwer, Willakenzie, and more steeply sloping Yamhill soils. These areas are less than 2 acres in size and occupy less than 10 percent of the total acreage. Also included are areas of Stony land and of rock outcrop. These areas are less than an acre in size and occupy less than 2 percent of the total acreage.

This soil has moderately slow permeability. Roots can penetrate to depths of 30 to 40 inches. Tilth is good, and the soil can be cultivated most of the year except during winter and spring storms. The available water capacity is 5 to 7.5 inches. Surface runoff is slow, and the erosion hazard is slight in unprotected areas. Fertility is moderate.

Most of the acreage has been cultivated. Orchards, small grain, hay, and pasture plants are the principal

crops. Oak-grassland pasture is the major use in uncleared areas. Capability unit IIe-3; woodland group 3cl; wildlife group 3.

Yamhill silt loam, 7 to 12 percent slopes (YaC).-On this soil runoff is slow to medium. Erosion is a moderate hazard in unprotected areas during rainy periods. The main crops are orchard fruit, small grain, hay, and pasture plants. Oak-grassland pasture is the major use. in uncleared areas. Capability unit IIIe-2; woodland group 3cl; wildlife group 3.

Yamhill silt loam, 12 to 20 percent slopes (YaD).-On this soil runoff is medium, and the erosion hazard is moderate in unprotected areas during rainy periods. This soil is not well suited to houses that have septic tanks because of possible seepage of effluent on the moderately steep slopes. The main crops are orchard fruits, small grain, hay, and pasture plants. Oak-grassland pasture is the major use in uncleared areas. Capability unit IIIe-2; woodland group 3cl; wildlife group 3.

Yamhill silt loam, 20 to 30 percent slopes (YaE).-This soil has a profile similar to Yamhill silt loam, 2 to 7 percent slopes, except that it has steep slopes and a rooting depth of 20 to 40 inches. Similar crops are grown. Runoff is medium, and the erosion hazard is severe. More intensive management practices, such as stripcropping, terraces, and diversions, are required. Capability unit IVe-2; woodland group 3cl; wildlife group 3.

Yamhill silt loam, 30 to 50 percent slopes (YaF).-This soil is similar to Yamhill silt loam, 2 to 7 percent slopes, except that it has very steep slopes and a rooting depth of 20 to 40 inches.

Included with this soil in mapping are areas of less steep Yamhill soils and shallow and stony soils. These areas are as much as 3 acres in size and occupy as much as 15 percent of some mapped areas.

Runoff is medium, and the erosion hazard is severe in unprotected areas. Oak-grassland pasture is the principal use, but Douglas-fir also is grown. Management is moderately difficult. Capability unit VIe-5; woodland group 3c2; wildlife group 4.

Yamhill silt loam, moderately shallow, 2 to 7 percent slopes (YhB).-This soil has the same profile characteristics as Yamhill silt loam, 2 to 7 percent slopes, except that the rooting depth is 20 to 30 inches to basalt rock. The available water capacity is 3.5 to 5 inches. Surface runoff is slow, and the erosion hazard is slight.

Included with this soil in mapping are areas of similar soils that contain as much as 30 percent basalt pebbles and stones. These areas are as much as 3 acres in size and occupy as much as 15 percent of some mapped areas.

Small grain, hay, and pasture plants are the principal crops. Uncultivated areas are in oak-grassland pasture and small Douglas-fir woodlots. Capability unit IIIe-4; woodland group 3cl; wildlife group 3.

Yamhill silt loam, moderately shallow, 7 to 20 percent slopes (YhD).-This soil has the same profile as Yamhill silt loam, 2 to 7 percent slopes, except that the rooting depth is 20 to 30 inches to basalt rock.

Included with this soil in mapping are areas of similar soils that contain as much as 30 percent pebbles and stones throughout the profile. These inclusions make up as much as 15 percent of some mapped areas.

The available water capacity is 3.5 to 5 inches. Surface runoff is slow to medium, and the erosion hazard is moderate in unprotected areas during rainy periods.

Small grain, hay, and pasture plants are grown. Uncultivated areas are in oak-grassland pasture and small Douglas-fir woodlots. Capability unit IVe-1; woodland group 3cl; wildlife group 3.

Use and Management of the Soils

This section describes use and management of the soils of the Yamhill Area for crops and pasture. It also discusses woodland, wildlife, and engineering uses of the soils and use of the soils for town and country planning.

Management for Crops and Pasture

Among the dryland crops commonly grown in the survey area are winter wheat, spring barley, alfalfa, prunes, walnuts, and red clover and bentgrass for seed. Irrigated crops commonly grown are strawberries, blackberries, pole beans, and sweet corn. In addition, some acreage is used for irrigated pasture. In the following pages, practices suitable for soils used for these main crops are described. First, the system of capability classification is explained and management suitable for the soils of each capability unit is discussed. Then, predicted average acre yields of the principal crops are given for a high level of management. Finally, specific management practices are described for each of the crops for which predicted average acre yields are given.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, all kinds of soils are grouped at three levels, the capability class, the subclass, and the unit. These levels are described in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife habitat. (None in the Yamhill Area.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, -wildlife habitat, or water supply, or to esthetic purposes.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter e shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultiva tion. (in some soils the wetness can be partly corrected by artificial drainage) ; *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States but not in the Yamhill Area, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain at the most, only the subclasses indicated by *w, s,* and *c,* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture or range, -woodland, wildlife habitat, or recreation.

Capility Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and otlier responses to management. Thus, the capabilityunit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numberal to thesubclass symbol, for example, IIe-4 or IIIe-6. Thus, in one symbol, the Roman muneral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability units

In the following pages, the capability units in the Yamhill Area are described and suggestions for use and management of the soils of each unit are given. The names of soil series represented are mentioned in the description of each capability unit, but this does not mean that all the soils of a given series are in the unit. To find the names of all the soils in any given capability unit, refer to the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT I-1

This unit consists of very deep, well-drained Chehalis and Williamette soils that have slopes of 0 to 3 percent. Annual precipitation is 40 to 60 inches, and the frost-free period is 165 to 212 days. These soils have high fertility. The available water capacity is 11 to 13 inches. Permeability is moderate. Surface runoff is slow, and the erosion hazard is slight.

The soils in this unit are used for vegetables, berries, bulbs, orchards, grain, seed crops, hay, and pasture crops.

Practices that provide regular additions of organic matter consist of returning all crop residue to the soil, growing cover or green-manure crops and including in the cropping system crops that produce a large amount of residue. Soils used for vegetable crops, orchards, bulbs, and berries should have a fertilized winter cover crop or green-manure crop planted in fall. Grain crops should be rotated with soil-conserving crops that are grown as much as 25 percent of the time. These soils are well suited to sprinkler irrigation, water for which is obtained from streams, ponds, or deep wells.

Berries, vegetable crops, and bulbs respond to nitrogen, phosphorus and potassium fertilizer and to sulfur, and in some places to boron. Grain and grass crops respond to nitrogen. Legumes respond to phosphorous fertilizer and sulfur, and in many places they respond to boron and lime. Orchard trees respond to nitrogen and potassium fertilizer and they also respond to boron. Excessive cultivation can result in the formation of a tillage pan. The pan can be broken by subsoiling. Symphilids are a serious concern in some areas.

CAPABILITY UNIT IIe-1

The only soil in this capability unit is Willamette silt loam, 3 to 12 percent slopes. This soil is very deep and well drained. Annual precipitation is 40 to 50 inches, and the frost-free period is 165 to 210 days. The soil has high fertility. The available water capacity is 11 to 13 inches. Permeability is moderate, surface runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil is used for vegetables, berries, bulbs, orchards, grain, seed crops, hay, and pasture crops.

Sheet and rill erosion are controlled by growing cover crops. Grassed waterways and cross-slope tillage are also used. A sprinkler system should be used to apply irrigation water carefully in order to prevent runoff. Water for irrigation is obtained from streams, ponds, or deep wells. A suitable cropping system provides soil-building crops 25 to 50 percent of the rotation.

Berries, vegetable crops, and bulbs respond to nitrogen, phosphorus, potassium, sulfur, and in places to boron. Grain and grass crops respond to nitrogen. Legumes respond to phosphorus, sulfur, boron, and lime. Orchard trees respond to nitrogen, potassium, and boron.

CAPABILITY UNIT IIe-2

The only soil in the capability unit is Knappa silty clay loam, 0 to 7 percent slopes. This soil is very deep and well drained. Annual precipitation is 60 to 70 inches, and the frost-free period is 165 to 210 days. This soil has moderate fertility. The available water capacity is 11 to 13 inches. Permeability is moderate, surface runoff is slow, and the erosion hazard is slight.

The soil in this unit is best suited to grain, grass and legume seed, hay, and pasture. Berries are grown in places.

A suitable cropping system provides soil-building crops for 225 to 50 percent of the rotation. This soil is suited to sprinkler irrigation, but water should be applied slowly enough to prevent erosion. Water for irrigation is obtained from streams or deep wells. Cross-slope tillage and grassed waterways are required in some gently undulating areas to help control erosion.

All crops except legumes need nitrogen fertilizer. Legumes respond to phosphorus and, in places, to boron and sulfur. Lime is needed to reduce soil acidity for legumes. Berries respond to phosphorus and potassium. Excessive cultivation can result in the formation of a tillage pan. The pan can be broken by subsoiling.

CAPABILITY UNIT IIe-3

The soils in this unit. are deep, well-drained soils of the Jory and Yamhill series. Slopes are 2 to 7 percent. Annual precipitation is 40 to 60 inches, and the frost-free period is 165 to 210 days. The soils have moderate fertility. The available water capacity is 5 to 11.5 inches. Permeability is moderately slow, surface runoff is slow, and the erosion hazard is slight.

These soils are used for berries, orchards, grain, grass and legumes, see, hay, and pasture plants. Vegetable crops are grown in places.

Organic-matter content can be maintained by using crop residue, green manure, and cover crops and a cropping system that provides soil-building crops 25 to 50 percent of the time. Soils used for orchards and berries need a fertilized fall-planted cover crop. Cross-slope tillage and grassed waterways protect the soil against erosion. Small areas can be irrigated by sprinklers, water for which is obtained from ponds.

Legumes respond to phosphorus and, in places, to boron and sulfur. Lime is needed to reduce acidity. Grain and grass crops respond to nitrogen. Berries and vegetable crops respond to nitrogen, phosphorus, and potassium. Orchard trees respond to nitrogen and boron.

CAPABILITY UNIT IIe-4

The only soil in this capability unit is Woodburn silt loam, 7 to 12 percent slopes. It is very deep and moderately well drained. Annual precipitation is 40 to 50 inches, and the frost-free period is 165 to 210 days. The soil has high fertility. The available water capacity is 11 to 13 inches. Permeability is moderate in the upper part of the soil and slow in the lower part. Surface runoff is slow, and the erosion hazard is slight.

This soil is used for vegetables, bulbs, orchards, grain, seed crops, hay, and pasture plants.

Erosion on short slopes is controlled by cross-slope farming, cover crops, and grassed waterways. A suitable cropping system provides soil-building crops 25 to 50 percent of the time. Tile systems and subsoiling should be across the slope. Irrigation water should be applied by sprinklers slowly enough that it can be absorbed by the soil. Water for irrigation is obtained from streams, ponds, or deep wells.

Grain and grass crops respond to nitrogen. Legumes respond to phosphorus and, in places to boron and sulfur. Lime is needed to reduce acidity. Orchard trees respond to nitrogen and boron. Vegetable crops and berries respond to nitrogen, phosphorus, potassium, and in places to sulfur.

CAPABILITY UNIT IIw-1

This unit consists of very deep, well-drained soils of the Chehalis, Cloquato, and Newberg series. Slopes are 0 to 3 percent. Annual precipitation is 40 to 60 inches, and the frost-free period is 165 to 210 days. Fertility is high. The available water capacity is 6 to 13 inches. Permeability is moderately rapid to moderately slow. Surface runoff is slow, and the hazard of erosion from river overflow (figs. 12 and 13) is slight to severe.

These soils are suited to crops that can withstand winter overflow and can protect the soils against it. Vegetables, bulbs, orchard fruit, grain, seed crops, hay, and pasture plants are the major crops. Berries are grown in places.

Organic-matter content can be maintained through use of crop residue, cover crops, and crop rotation. Where grain is grown, the cropping system should include pasture, hay, or legumes or grasses for seed for as much as 25 percent of the time. All soils used for crops that do not leave a dense cover during winter should be planted to a well-fertilized cover crop early in fall. Crop residue should be left standing over winter. Sprinkler irrigation is widely used on these soils, water for which is obtained from shallow wells or streams. Excessive cultivation can cause formation of a tillage pan. Subsoiling in spring helps to break the pan.

The grain and grass crops respond to nitrogen. Legumes respond to phosphorus, sulfur, and boron. Vegetable crops and berries respond to nitrogen, phosphorus, potassium, and in places, to sulfur. Orchard trees respond to nitrogen, potassium, and boron.

CAPABILITY UNIT IIw-2

The only soil in this capability unit is Amity silt loam. It is very deep and somewhat poorly drained. Slopes are 0 to 2 percent. Annual precipitation is 40 to 45 inches, and the frost-free period is 165 to 210 days. The soil has moderate fertility. Available water capacity is 11 to 13 inches. Permeability is moderately slow, surface runoff is slow, and the erosion hazard is slight.

This soil is used to grow vegetables, small grain, grass seed, hay, and pasture plants.

All crop residue should be returned to the soil. Where grain crops are grown, cover crops and a cropping system that includes soil-building crops for as much as 25 percent of the rotation help maintain fertility. Where vegetable crops and spring grain are grown, a well-fertilized, fall-planted cover crop protects the soil during winter. This soil has a perched water table during winter and early in spring. Deep tile systems remove much of this excess water and lengthen the season of use. Subsoiling across

Figure 12-Debris left on an orchard of young cherry trees along the Willamette River after winter flooding. The soil is Cloquato silt loam of capability unit IIw-1.

the tile lines improves the efficiency of the system. Sprinkler irrigation is used on this soil for vegetable crops and pasture. Irrigation water is obtained from ponds, deep wells, or streams.

Grain and grass crops need nitrogen fertilizer. Legumes respond to phosphorus and in places to boron and sulfur. In places lime is needed to reduce acidity. Vegetable crops respond to nitrogen, phosphorus, potassium, and in places to boron. Excessive cultivation can result in formation of a tillage pan which can be broken by subsoiling. Symphilids are a serious concern in some areas.

CAPABILITY UNIT IIw-3

The only soil in this capability unit is Newberg fine sandy loam. It is very deep and somewhat excessively drained. Slopes are 0 to 3 percent. Annual precipitation is 40 to 60 inches, and the frost-free period is 165 to 210 days. Fertility is moderate. The available water capacity is 4 to 7 inches. Permeability is rapid, surface runoff is slow, and the erosion hazard from river overflow is slight to severe.

The soil in this unit is suited to crops that can withstand winter overflow and can protect the soils against it. Vegetables, bulbs, orchard fruit, grain, seed crops, hay, and pasture plants are the major crops. Berries are grown in places. Where grain is grown, organic-matter content can be maintained by returning crop residue to the soil, growing cover crops, and using a cropping system that includes pasture, hay, and legume or grasses for seed for as much as 25 percent of the rotation. Where the soil is used for crops that do not leave a dense cover during winter, a well-fertilized cover crop planted early in the fall gives protection from possible erosion during overflow. Crop residue should be left on the soil during winter. Sprinkler irrigation is required for intensively farmed crops, and is beneficial for most crops. Water

Figure 13-Damage caused by overflow on an unprotected Chehalis soil of capability unit IIw-1 during a storm in winter.

for irrigation is obtained from shallow wells or from streams.

The grain and grass crops respond to nitrogen. Legumes benefit from phosphorus, boron, and sulfur. Vegetable crops and berries need nitrogen, phosphorus, and potassium. Orchard trees respond to nitrogen, potassium, and boron.

CAPABILITY UNIT IIw-4

The only soil in this capability unit is Carlton silt loam, 0 to 7 percent slopes. This soil is very deep and moderately well drained. Fertility is moderately high. Annual precipitation is 40 to 50 inches, and the frost-free period is 165 to 210 days. The available water capacity is 10 to 12 inches. Permeability is moderately slow, surface runoff is slow, and the erosion hazard is slight.

Small grain, seed crops, hay, and pasture plants are the major crops. Berries and orchards are grown where drainage has been improved. Vegetable crops are grown in places.

Cover crops and a cropping system that provides soil-building crops 25 to 50 percent of the rotation help maintain fertility. All crop residue should be returned to the soil. Where berries and orchard trees are grown, a well-fertilized cover crop planted in fall protects the soil during winter. During the winter and early in spring, this soil receives seepage from higher lying soils and can develop a perched water table. Deep tile drains can be installed to intercept and remove excess water and lengthen the season of use. Subsoiling across the tile lines improves the efficiency of the system. Sprinkler irrigation is used for some crops. Water for irrigation is obtained from ponds or deep wells.

Grain and grass need nitrogen fertilizer. Legumes respond to phosphorus, boron, and sulfur. Lime is generally required to reduce acidity. Vegetable crops respond to nitrogen, phosphorus, potassium, and in places to boron. Orchard trees respond to nitrogen, boron, and potassium. Excessive cultivation can cause a tillage pan, which can be broken by subsoiling.

CAPABILITY UNIT IIw-5

The only soil in this capability unit is McBee silty clay loam. It is very deep and moderately well drained. Slopes are 0 to 2 percent. Annual precipitation is 40 to 60 inches, and the frost-free period is 165 to 210 days. The soil has moderate fertility. The available water capacity is 11 to 13 inches. Permeability is moderate, surface runoff is slow, and there is a slight hazard of erosion from overflow.

This soil is used to grow vegetable crops, spring grain, hay, and pasture plants.

Where grain crops are grown, organic-matter content can be maintained through use of crop residue, cover crops, and a cropping system that provides soil-building crops for as much as 25 percent of the rotation. For crops that do not leave a dense winter cover, a well-fertilized

cover crop planted early in fall protects the soil against erosion from overflow. Crop residue should be left standing over winter. This soil has a high water table during winter and is ponded for short periods. Deep tile systems and surface smoothing remove much of this excess water. Sprinkler irrigation is used for vegetable crops and pasture. Water for irrigation is obtained from streams or shallow wells.

Grain and grass crops need nitrogen fertilizer. Legumes require phosphorus and, in places, sulfur and boron. Vegetable crops need nitrogen, phosphorus, potassium, and, in places, boron. Excessive cultivation can result in the formation of a tillage pan that requires subsoiling in the spring.

CAPABILITY UNIT IIIw-6

This unit consists of very deep, moderately well drained or somewhat poorly drained soils of the Aloha and Woodburn series. Slopes are 0 to 7 percent. Annual precipitation is 40 to 50 inches, and the frost-free period is 165 to 210 days. These soils have high fertility. The available water capacity is 11 to 13 inches or more. The Woodburn soil is moderately permeable in the upper part and slowly permeable in the lower part. Permeability of the Aloha soil is moderately slow. Surface runoff is slow, and the erosion hazard is slight.

These soils are used to grow vegetables, bulbs, orchard trees, grain, seed crops, hay, and pasture plants. Most berry crops and some legumes are longer lived if soil drainage is provided.

All crop residue should be returned to the soil. Where grain crops are grown, fertility can be maintained through use of cover crops, green manure crops, and a cropping system that includes soil-building crops, such as pasture, hay, or legumes and grass for seed, for as much as 25 percent of the rotation. A perched water table forms in these soils during rainy periods. Strawberries, alfalfa, and other crops that require good drainage can be grown if a deep, random tile system is installed to remove the perched water. Soil normally left bare over winter should be planted to a well-fertilized, fall-planted cover crop. Sprinkler irrigation is used on these soils, water for which is obtained from ponds, deep wells, or a stream.

Grain and grass crops need nitrogen. Legumes respond to phosphorus, boron, and sulfur. Lime is needed to reduce acidity. Orchard trees respond to nitrogen and boron. Vegetable crops and berries respond to nitrogen, phosphorus, potassium, and in places to sulfur. Execss1ve cultivation can result in formation of a tillage pan that. requires subsoiling. Symphilids are a serious concern in some areas.

CAPABILITY UNIT IIs-1

The only soil in this capability unit is well-drained Briedwell silt loam. Slopes are 0 to 3 percent. Annual precipitation is 40 to 45 inches, and the frost-free period is 165 to 210 days. Fertility is moderate. The available water capacity is 6 to 7.5 inches. Permeability is moderate, surface runoff is slow, and the erosion hazard is slight.

This soil is used for vegetables, berries, grain, seed crops, hay, and pasture plants.

Organic-matter content can be maintained by use of crop residue, cover or green manure crops, and a cropping system that provides soil-conserving crops for 25 percent of the rotation. Small areas can be sprinkler irrigated from deep wells. Excessive cultivation can form a tillage pan that may need subsoiling.

Vegetable crops and berries need nitrogen. Legumes need phosphorus, sulfur, and boron and lime in places.

CAPABILITY UNIT IIIe-1

The only soil in this capability unit is Willamette silt loam, 12 to 20 percent slopes. It is very deep and well drained. Annual precipitation is 40 to 50 inches, and the frost-free period is 165 to 210 days. The soil has high fertility. The available water capacity is 11 to 13 inches. Permeability is moderate, surface runoff is medium, and the erosion hazard is moderate.

This soil is used for orchards, alfalfa, small grain, legumes for seed, and hay and pasture plants. Berries and vegetable crops are grown in places.

All tillage and planting should be across the slope, and winter cover crops are needed to help control sheet and rill erosion. Grassed waterways help remove runoff water. Irrigation water should be applied by sprinkler and slowly enough that it can be absorbed by the soil. Water for irrigation is obtained from streams, ponds, or deep wells. A suitable cropping system provides soil-building crops 50 to 75 percent of the rotation.

Berries and vegetable crops respond to nitrogen, phosphorus, potassium, sulfur, and in places to boron. Grain and grass crops respond to nitrogen. Legumes respond to phosphorus, sulfur, boron, and lime. Orchard trees respond to nitrogen, potassium, and boron.

CAPABILITY UNIT IIIe-2

This unit consists of well-drained soils of the Jory, Laurelwood, Peavine, Willakenzie, and Yamhill series. Slopes are 12 to 20 percent. Annual precipitation is 40 to 70 inches, and the frost-free period is 165 and 210 days. The soils have moderate fertility. The available water capacity is 5 to 12 inches. Permeability is moderate and moderately slow. Surface runoff is slow to medium, and the erosion hazard is moderate to severe. Small surface slides develop in places during periods of heavy rain.

These soils are used for orchards, berries, grain, grass and legume seed, hay, and pasture plants.

Organic-matter content can be maintained by using crop residue, green manure, and cover crops. A suitable cropping system provides soil-building crops 50 to 75 percent of the time. Soil used for orchards and berries should have a fertilized fall-planted cover crop (fig. 14). Cross-slope tillage, cover crops, and grassed waterways help protect the soil against erosion and slippage. Small areas can be irrigated by sprinklers, water for which is obtained from ponds.

Grain and grass crops respond to nitrogen fertilizer. Legumes need phosphorus, sulfur, and boron. Lime is needed to reduce acidity. Orchard trees respond to nitrogen, potassium, and boron. Berries respond to nitrogen, phosphorus, and potassium.

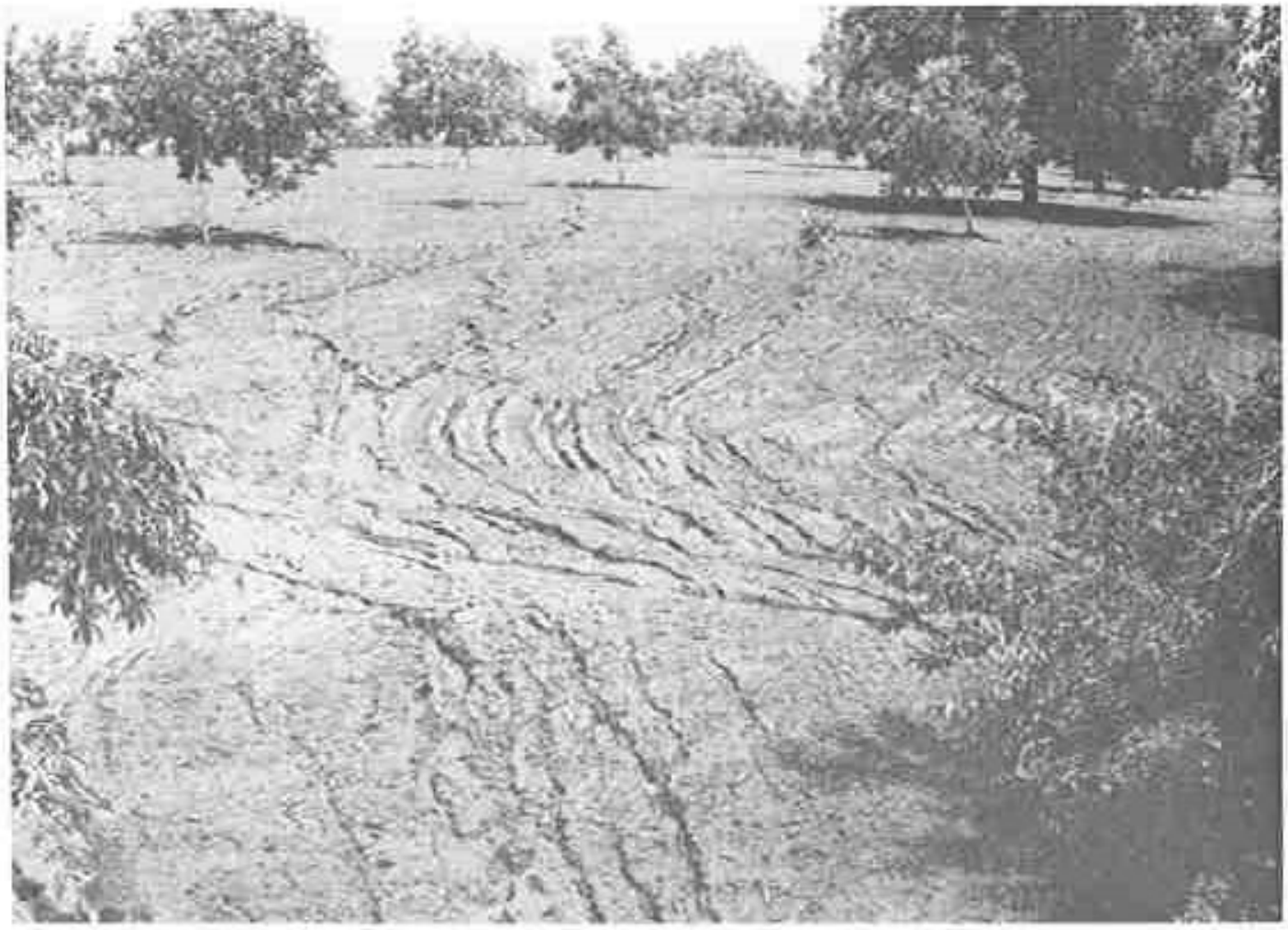

Figure 14.-Erosion caused by a rainstorm late in summer on unprotected Willakenzie soils of capability unit IIIe-2. Orchards of prune and walnut trees are commonly clean cultivated before the fruits and nuts fall from the trees and are picked up off the ground. Erosion is a hazard where the soils are bare.

CAPABILITY UNIT IIIe-3

This unit consists of soils of the Hazelair series and Hazelair acid variant, that are moderately deep over clay and moderately well drained and somewhat poorly drained. Slopes are 2 to 7 percent. Annual precipitation is 40 to 60 inches, and the frost-free period is 165 to 210 days. These soils have low fertility. The available water capacity is 4 to 7 inches. Permeability is slow, surface runoff is slow, and the erosion hazard is slight.

These soils are used for grain, grass seed, hay, and pasture plants.

Organic-matter content can be maintained or improved by using all crop residue and a cropping system that provides soil-building crops 50 to 75 percent of the rotation. Sheet and rill erosion can be controlled by cross-slope farming and grass waterways. Deep underground tile systems intercept and remove excess water caused by the perched water table and seepage during the winter and early in spring.

Grain and grass crops respond to nitrogen. Legumes require phosphorus, boron, sulfur, and lime.

CAPABILITY UNIT IIIe-4

This unit consists of moderately shallow, well-drained soils of the Nekia, Peavine, Willakenzie, and Yamhill series. Slopes are 2 to 7 percent. Annual precipitation is 40 to 70 inches, and tile frost-free period is 165 to 210 days. These soils have moderate fertility. The available water capacity is 3 to 7 inches. Permeability is moderately slow, surface runoff is slow, and the erosion hazard is slight to moderate. During periods of heavy rain, small surface slides develop on soils underlain by sedimentary rock.

These soils are used for grain, grass and legume seed, hay, and pasture plants. Shallow-rooted orchard trees and berries are grown in places.

Cross-slope farming and grassed waterways help control erosion and soil slippage. A suitable cropping system provides soil-building crops 50 to 75 percent of the rotation.

Grain and grass crops respond to nitrogen fertilizer. Legumes need phosphorus, sulfur, boron, and lime.

Orchard trees respond to nitrogen, potassium, and boron. Berries respond to nitrogen, phosphorus, and potassium.

CAPABILITY UNIT IIIe-5

The only soil in this capability unit is Woodburn silt loam, 12 to 20 percent slopes. This is a very deep, moderately well drained soil. Annual precipitation is 40 to 50 inches, and the frost-free period is 165 to 210 days. This soil has high fertility. The available water capacity is 11 to 13 inches. Permeability is moderate in the upper part of the soil and slow in the lower part. Surface runoff is medium, and the erosion hazard is moderate.

This soil is used for vegetables, bulbs, orchards, grain, seed crops, hay, and pasture plants. Berries and vegetable crops are less well suited to this soil and require more careful and intensive management.

A suitable cropping system provides soil-building crops for 50 to 75 percent of the rotation. All tillage and planting should be across the slope, and winter cover crops are needed to help control sheet and rill erosion. Grassed waterways help divert runoff water from the more level soils nearby. Tillage should be limited to seedbed preparation and weed control. The soil should be left in a cloddy condition to protect against erosion during rainy periods. Tile systems should be across the slope. Sprinkler irrigation can be used, but water should be applied slowly enough to prevent erosion. Water for irrigation is obtained from streams, ponds, or deep wells.

CAPABILITY UNIT IIIe-6

This unit consists of moderately well drained and somewhat poorly drained Carlton, Chehalem, and Dupee soils. Slopes are 3 to 12 percent. Annual precipitation is 40 to 60 inches, and the frost-free period is 165 to 210 days. The soils have moderate and moderately high fertility. The available water capacity is 8 to 14 inches. Permeability is moderately slow to slow, surface runoff is slow to medium, and the erosion hazard is slight to moderate.

These soils generally are suited to small grain, seed crops, hay, and pasture. Orchards on the Chehalem. soil need intensive drainage. Tilling and planting across the slope and growing winter cover crops help control erosion. Grassed waterways help remove runoff water from higher lying soils. A suitable cropping system provides soil-building crops for 50 to 75 percent of the rotation. Tile drainage systems should be across the slope to intercept water. Sprinkler irrigation water should be applied slowly enough that it can be absorbed by the soil. Water for irrigation is obtained from streams, ponds, or deep wells.

CAPABILITY UNIT IIIw-1

The only soil in this capability unit is Dayton silt loam, thick surface. The soil is moderately deep to the clay subsoil and poorly drained. Slopes are 0 to 2 percent. Annual precipitation is 40 to 45 inches, and the frost-free period is 165 to 210 days. Fertility is low to moderate. This soil has very slow permeability. The available water capacity is 4.5 to 6 inches. Surface runoff is slow to ponded, and the hazard of erosion is slight.

Grain, vegetables, some berries, grass seed, hay, and pasture plants are important crops.

This soil has a perched water table over the clay subsoil during winter and early in spring. Drainage can be improved by surface smoothing and deep tile systems. Tile trenches should be filled with permeable material. Because the relief is almost level, adequate tile outlets may not be available. Sprinkler irrigation is used on vegetable crops, hay, and pasture plants. Water for irrigation is obtained from ponds, streams, or deep wells.

Grain and grass crops respond to nitrogen. Legumes need phosphorus, sulfur, lime, and boron. Vegetable crops and berries need nitrogen, phosphorus, and potassium. Organic-matter content can be improved and maintained by using crop residue, green manure, cover crops, and a cropping system that provides soil-building crops for 25 percent of the rotation. Fall-plowed soil should be left cloddy to maintain soil structure.

CAPABILITY UNIT IIIw-2

The only soil in this capability unit is poorly drained Cove silty clay loam, thick surface. Slopes are 0 to 2 percent. Annual precipitation is 40 to 60 inches, and the frost-free period is 165 to 210 days. This soil has moderately low fertility. The available water capacity is 6 to 7.5 inches. Permeability is very slow, surface runoff is very slow to ponded, and the erosion hazard is slight.

This soil is used to grow spring grain, vegetable crops, berries, grass seed, hay, and pasture plants.

Organic-matter content can be maintained by using crop residue, cover crops, and a cropping system that provides soil-building crops for 25 percent of the rotation. Crop residue should be left on the soil over winter. Where crops do not provide adequate cover, a well-fertilized cover crop planted early in the fall protects the soil against erosion from overflow. This soil has a water table late in fall, in winter, and early in spring. Some ponding occurs during and after overflow. Drainage can be improved by surface smoothing and open ditches. Where adequate outlets are available, deep tile systems are used for drainage. Trenches should be filled with permeable material. Sprinkler irrigation is used for vegetable crops, hay, and pasture plants. Water for irrigation is obtained from streams or shallow wells.

Grain and grass crops need nitrogen. Legumes respond to phosphorus, sulfur, boron, and lime. Vegetable crops and berries respond to nitrogen, phosphorus, potassium, and sulfur.

CAPABILITY UNIT IIIw-3

The only soil in this capability unit is Labish mucky clay. It is a deep, poorly drained clay soil underlain by peat. Slopes are nearly level. Annual precipitation is 42 inches, and the frost-free period is 165 to 210 days. The available water capacity is 12 to 16 inches. Fertility is high. Permeability is slow, surface runoff is very low to ponded, and the hazard of erosion is slight.

Vegetables, onions, and spring grain are the principal crops. Hay and pasture plants are also grown.

The natural organic-matter content of this soil is very high. It can be maintained by using crop residue, green manure, and cover crops, and limiting tillage to preparing a seedbed and controlling weeds. Excessive

tillage makes the soils subject to occasional soil blowing in the summer, and flotation and removal of soil material by water that normally ponds on the soil most of the winter. The areas of this soil are encircled by a dike. The water table is controlled during the growing season by a drainage system of underground wooden drains and open ditches that convey the water to a pumping plant. Excess water is discharged into ditches outside of the dike.

Grain and grass crops respond to nitrogen fertilizer. Vegetable crops and onions respond to nitrogen, phosphorus, potassium, and lime.

CAPABILITY UNIT IIIw-4

The only soil in this capability unit is Grande Ronde silty clay loam. It is moderately deep to clay and somewhat poorly drained. Slopes are 0 to 2 percent. Annual precipitation is 60 to 80 inches, and the frost-free period is 165 to 210 clays. The available water capacity is 8.5 to 10 inches. Fertility is low. Permeability is slow, surface runoff is slow, and the erosion hazard is slight.

Spring grain, grass seed, hay, and pasture plants are the principal crops.

Organic-matter content can be maintained by using crop residue, green manure, cover crops, and a cropping system that provides soil-building crops for 25 percent of the rotation. This soil has a perched water table over the clay subsoil during winter and early in spring. Drainage can be improved by surface smoothing and deep tile systems. Tile trenches should be filled with permeable material. Sprinkler irrigation can be used for the hay and pasture plants. Water for irrigation is obtained from streams.

Grain and grass crops respond to nitrogen. Legumes need lime, phosphorus, sulfur, and boron.

CAPABILITY UNIT IIIw-5

The only soil in this capability unit is Wapato silty clay loam. It is deep and poorly drained. Slopes are 0 to 3 percent. Annual precipitation is 40 to 45 inches, and the frost-free period is 65 to 210 days. Fertility is moderate. The available water capacity is 10 to 12 inches. Permeability is moderately slow. Surface runoff is slow and water ponds during overflow. The erosion hazard is slight.

This soil is used to grow vegetables, berries, grain, grass seed, hay, and pasture plants.

Organic-matter content can be improved and maintained by using cover crops, crop residue, and a cropping system that provides soil-building crops for 25 percent of the rotation. Where crops do not provide adequate residue, a well-fertilized cover crop planted early in fall protects the soil against erosion from overflow in winter (fig. 15). Crop residue should be left on the soil over winter. Where adequate outlets are available, deep tile systems can be installed to remove excess water. Sprinkler irrigation is used on this soil. Water for irrigation is obtained from streams or shallow wells.

Grain and grass crops respond to nitrogen fertilizer. Legumes respond to phosphorus, sulfur, boron, and lime. Vegetable crops respond to nitrogen, phosphorus, and potassium.

CAPABILITY UNIT IVe-1

This unit consists of moderately shallow, well-drained soils of the Nekia, Peavine, Steiwer, Willakenzie, and Yamhill series. Slopes are 3 to 20 percent. Annual precipitation is 40 to 70 inches, and the frost-free period is 165 to 210 days. These soils have low to moderate fertility. The available water capacity is 3 to 8 inches. Permeability is moderate to moderately slow, surface runoff is slow to medium, and the erosion hazard is moderate to severe. During periods of heavy rain, small surface slides develop on some soils that overlie sedimentary rock.

These soils are used to grow grain, grass and legume seed, hay, and. pasture plants. Shallow-rooted orchard trees are grown in places.

All tillage and planting should be done across the slope to help control erosion and soil slippage. Grassed waterways help remove runoff water. Soils should be left cloddy to protect against erosion during rainy periods. Tillage should be limited to seedbed preparation and weed control. A suitable cropping system provides soil-building crops for more than 75 percent of the rotation. Stripcropping, terraces, and diversions are needed on long slopes.

Grain and grass crops respond to nitrogen fertilizer. Legumes respond to phosphorus, sulfur, boron, and lime. Orchard trees respond to nitrogen, potassium, and boron.

CAPABILITY UNIT IVe-2

This unit consists of deep, well-drained soils of the Jory, Laurelwood, Peavine, Willakenzie, and Yamhill series. Slopes are 2 to 30 percent. Annual precipitation is 40 to 70 inches, and the frost-free period is 165 to 210 days. These soils have moderate fertility. The available water capacity is 5 to 12 inches. Permeability is moderate to moderately slow, surface runoff is slow to medium, and the erosion hazard is slight to severe. Small surface slides can develop during periods of heavy rain.

These soils are used mostly for orchards, grain, and grasses and legumes grown for seed, hay, and pasture. The soils that have slopes of 2 to 30 percent are used mainly for growing timber, but a few areas are used for hay and pasture. Jory clay loam, 2 to 30 percent slopes, Laurelwood silt loam, 3 to 30 percent slopes, and Peavine silty clay loam, 2 to 30 percent slopes, were included in this capability unit because they were mapped at a lesser intensity than the other soils. In places, areas of those soils are large enough to consider using them for berry and vegetable crops, as well as for orchard trees, grain crops, grasses and legumes grown for seed, hay, and pasture.

Organic-matter content of these soils can be maintained by using crop residue, green manure, cover crops, and a cropping system that provides soil-building crops for more than 75 percent of the rotation. Soils used for orchards and berries should have a fall-planted, fertilized cover crop. Stripcropping, terraces, and diversions are needed on long slopes. Cross-slope tillage, grassed waterways, and rough tillage help protect the soil against erosion and slippage.

Grain and grass crops respond to nitrogen fertilizer. Legumes respond to phosphorus, sulfur, boron, and

Figure 15-Grassed waterway used to protect a field of Wapato silty clay loam from erosion caused by overflow. Cultivated Woodburn soils are on either side of the Wapato soil.

lime. Orchard trees respond to nitrogen, potassium, and boron.

CAPABILITY UNIT IVe-3

The only soil in this capability unit is Hazelair silty clay loam, 7 to 20 percent slopes. It is moderately deep to clay and somewhat poorly drained. Annual precipitation is 40 to 60 inches, and the frost-free period is 105 to 210 days. This soil has low fertility. The available water capacity is 4 to 7 inches. Permeability is slow, surface runoff is medium, and the erosion hazard is severe.

This soil is suited to grain, hay, and pasture.

All tillage and planting should be across the slope, and a winter cover crop is needed to help control erosion. Grassed waterways help remove excess water. Tillage should be limited to seedbed preparation and weed control. The soil should be left cloddy to protect against erosion during rainy periods. A suitable cropping system provides soil-building crops for more than 75 percent of the rotation. Deep underground tile systems intercept and remove excess water from a perched water table and seepage during winter and early in spring.

Grain and grass crops respond to nitrogen fertilizer. Legumes require phosphorus, boron, and sulfur, and lime.

CAPABILITY UNIT IVe-4

This unit consists of deep, moderately well drained to somewhat poorly drained soils of the Carlton and Dupee series. Slopes are 12 to 20 percent. Annual precipitation is 40 to 50 inches, and the frost-free period is 165 to 210 days. The available water capacity is 8 to 14 inches. The fertility is moderate or moderately high. Permeability is moderately slow, surface runoff is medium, and the erosion hazard is severe.

These soils are used for small grains, hay, pasture plants, and some orchards. A suitable cropping system provides soil-building crops for more than 75 percent of the rotation. Deep underground tile systems across the slope intercept and remove excess water caused by seepage from higher lying ground. All tillage and planting should be across the slope. The soil should be worked only to prepare a seedbed or for weed control and left in a cloddy condition during the winter. Well-fertilized winter cover crops in orchards and grass waterways help to control erosion.

Grain and grass crops respond to nitrogen fertilizer. Legumes respond to phosphorus, sulfur, boron, and lime. Orchard trees respond to nitrogen, potassium, and boron.

CAPABILITY UNIT IVw-1

The only soil in this capability unit is poorly drained Cove silty clay loam, fan. It is shallow to clay. Slopes are 2 to 7 percent. Annual precipitation is 40 to 60 inches, and the frost-free period is 165 to 210 days. The available water capacity is 4 to 10 inches. Fertility is low. Permeability is very slow, surface runoff is very slow and ponding often occurs in winter. The erosion hazard is slight.

Grass seed, hay, and pasture plants are the principal crops. Spring grain is grown in places.

Crop residue returned to the soil and a cropping system that provides soil-building crops for 25 percent of the rotation help improve and maintain the organic matter content. If this soil is plowed in fall, it should be left cloddy to protect soil structure and to control water erosion on the gentle slopes. This soil has a perched water table over the clay subsoil late in fall, in winter, and early in spring. It also receives seepage from higher lying areas. Drainage can be improved by open ditches and surface smoothing.

Grain and grass crops respond to nitrogen. Legumes need phosphorus, lime, sulfur, and, in places, boron and potassium.

CAPABILITY UNIT IVw-2

This capability unit consists of poorly drained soils of the Cove series. Slopes are 0 to 2 percent. Annual precipitation is 40 to 60 inches, and the frost-free period is 165 to 210 days. Fertility is low. The available water capacity is 3 to 6 inches. The soils have very slow permeability, surface runoff is slow to ponded, and the erosion hazard is slight.

Grass seed, hay, and pasture plants are the principal crops grown on these soils. Spring grain is grown in places where the surface layer is silty clay loam.

Organic-matter content of these soils can be improved and maintained by using crop residue and a cropping system that provides soil-building crops for 25 percent of the rotation. Where crops do not leave a dense winter cover, a well-fertilized cover crop planted early in the fall protects the soil against erosion caused by overflow. Drainage can be improved by open ditches and surface smoothing.

Grain and grass crops respond to nitrogen. Legumes need phosphorus, sulfur, boron, potassium, and lime.

CAPABILITY UNIT IVw-3

The only soil in this capability unit is poorly drained Dayton silt loam. Slopes are 0 to 2 percent. Annual precipitation is 40 to 45 inches, and the frost-free period is 165 to 210 days. Fertility is low. The available water capacity above the claypan is 3 to 4 inches. This soil has very slow permeability, surface runoff is slow to ponded, and the erosion hazard is slight.

Spring grain, grass for seed, hay, and pasture plants are the principal crops grown on this soil.

Organic-matter content of this soil can be improved and maintained by using crop residue, green manure crops, and a cropping system that provides soil-b uilding crops for 25 percent of the rotation. Fall-plowed soil should be left cloddy to protect soil structure. This soil has a perched water table over the clay subsoil late in fall, in winter, and in spring. Drainage can be improved by open ditches, surface smoothing, or deep tile systems. Tile trenches should be filled with permeable material. Because the topography is almost level adequate tile outlets may not be available. Sprinkler irrigation is used for some crops. Water for irrigation is obtained from deep wells, ponds, or streams.

Grain and grass crops respond to nitrogen. Legumes respond to phosphorus, potassium, sulfur, lime, and boron.

CAPABILITY UNIT VIe-1

This unit consists of Terrace escarpments and moderately shallow and deep, well-drained soils of the Steiwer series. Slopes are 20 to 40 percent. Annual precipitation is 40 to 60 inches, and the frost-free period is 165 to 210 days. The soils have low to moderate fertility. The available water capacity is 3.5 to 8 inches. Permeability is moderately slow and moderate, surface runoff is medium, and the erosion hazard in unprotected areas is severe.

These soils are used for pasture and woodland. They are too steep and shallow to be safely cultivated for crops, but the soils can be prepared for planting of trees or for seeding pasture plants.

The Steiwer soils are mostly in oak-grassland pasture. Some areas have been seeded to improved grass and legume pasture. The vegetation on Terrace escarpments is mostly mixed grass, oak, and Douglas-fir. The less steep slopes can be cleared and seeded to improved pasture. In places Terrace escarpments contains small seep spots in winter. Small slides and slumps also develop during heavy rains.

Grasses respond to nitrogen, and legumes require lime, phosphorus, and, in places, boron.

CAPABILITY UNIT VIe-2

This unit consists of Alluvial land and well-drained soils of the Astoria, Ead, Hembre, Melby, and Olyic series. Slopes are 3 to 30 percent. Annual precipitation is 60 to 110 inches, and the frost-free period is 145 to 200 days. The soils have moderate or moderately low fertility. The available water capacity is 3 to 12 inches. Permeability is moderate or moderately slow, surface runoff is slow to medium, and the erosion hazard in unprotected areas is moderate.

These soils are used mainly as woodland, but a few areas have been cleared for improved pasture. The heavy rainfall and generally strongly sloping to steep slopes make these soils unsuitable for cultivation. Pasture can be established and improved by heavy applications of lime, nitrogen, and phosphorus. Encroachment of brush

is a major concern in management. Soils on sedimentary rock have poor trafficability during long wet periods. Alluvial land is subject to frequent overflow following heavy rains and snow melt. Douglas-fir and some hemlock and cedar grow well on these soils. Conversion to other uses is not practical unless intensive management practices are applied. The soils are well suited to intensive woodland management.

CAPABILITY UNITVIe-3

This unit consists of well-drained Astoria, Ead, Hembre Melby, and Olyic soils. Slopes are 30 to 60 percent. Annual precipitation is 60 to 110 inches, and the frost-free period is 145 to 200 days. The soils have moderate or moderately low fertility. The available water capacity is 3 to 12 inches. Permeability is moderate or moderately slow, surface runoff is rapid, and the erosion hazard is severe in unprotected areas.
These soils are used as woodland. The heavy rainfall and steep and very steep slopes make these soils unsuitable for cultivation or improved pasture. Douglas-fir, hemlock, and cedar grow well on these soils. The steep and very steep slopes make woodland management difficult. Encroachment of brush on all these soils is difficult to control. Trafficability is poor on soils that overlie sedimentary rock and is difficult to improve.

CAPABILITY UNITVIe-4

This unit consists only of Shale rock land. This land type is shallow and very shallow, well-drained, clayey material that formed from sedimentary rock. Rock crops out on low hills. Slopes are 10 to 40 percent. Annual precipitation is 40 to 45 inches, and the frost-free period is 165 to 210 days. Fertility is low. The available water capacity is 2 to 5 inches. Permeability is moderate to slow, surface runoff is medium to rapid, and the erosion hazard is severe where this land type is unprotected
This land type is used for pasture. It is too shallow to be safely cultivated for crops, but can be prepared for seeding improved pasture. Many areas are still in oak-grassland and brushy pasture. Grasses need nitrogen. Legumes respond to lime, phosphorus, boron, and sulfur. Production is low because of the prolonged dryness -of the soil material and the generally warm southern exposures.

CAPABILITY UNIT VIe-5

This unit consists of well-drained soils of the Jory, Laurelwood, Peavine, Steiwer, Willakenzie, and Yamhill series. These soils formed over basalt, siltstone, and sandstone. Slopes are 30 to 60 percent. Annual precipitation is 40 to 70 inches, and the frost-free period is 165 to 210 days. The soils have moderate or low fertility. The available water capacity is 3.5 to 12 inches. Permeability is moderate to moderately slow, surface runoff is rapid to medium, and the erosion hazard is severe in unprotected areas. Small surface slides occur at times during periods of heavy rain.

These soils are used as woodland. The steep and very steep slopes make them unsuitable for cultivation or improved pasture. Some areas of the Willakenzie, Yamhill, and Steiwer soils are in oak-grassland. Douglas-fir grows well on the deep soils. The steep and very steep slopes make woodland management difficult. Poor trafficabil
ity on soils that formed from sedimentary rock is a major problem.

CAPABILITY UNIT VIw-1

The only soil in this capability unit is Panther silty clay loam, 4 to 20 percent slopes. It is shallow to clay and is poorly drained. Annual precipitation is 45 to 60 inches, and the frost-free period is 145 to 210 days. This soil has low fertility. The available water capacity is 2 to 4 inches to clay and 5 to 10 inches to a depth of 60 inches. Permeability is very slow, surface runoff is slow to medium, and the erosion hazard is slight.

This soil is used for pasture. It is too shallow and wet to be used for cultivated crops or woodland. Some areas are in oak-grassland pasture. Only water-tolerant grasses and legumes should be used for pasture. Drainage can be improved by ditches and tile systems that are placed to intercept water from higher lying soil. Tile trenches should be filled with permeable material.

Grass responds to nitrogen. Legumes need lime, phosphorus, and, in places, boron.

CAPABILITY UNIT VIs-1

This unit consists of Stony land and very shallow, shallow, and moderately deep, stony and very stony, well-drained soils of the Klickitat series. Slopes are 5 to 60 percent. Annual precipitation is 45 to 120 inches, and the frost-free season is 145 to 210 days. These soils have low fertility. The available water capacity is 2 to 4 inches. Permeability is moderately rapid or moderate, surface runoff is slow to rapid, and the erosion hazard is moderate to severe.

These soils are used as woodland. They are too stony, too shallow, and in places, too steep for cultivated crops or improved pasture. Many areas of Stony land are in oak-grassland pasture. Douglas-fir grows on these soils, although the soils are too droughty to be well suited to this species of tree. Management is difficult on the steeper slopes.

CAPABILITY UNIT VIIe-1

This unit consists of deep, well-drained soils of the Astoria, Hembre, Jory, and Olyic series. Slopes are 60 to 90 percent. Annual precipitation is 40 to 110 inches, and the frost-free period is 145 to 210 days. These soils have moderate fertility. The available water capacity is 6 to 12 inches. Permeability is moderate to moderately slow, surface runoff is rapid, and the erosion hazard is severe in unprotected areas.

These soils are used as woodland. The steep slopes make them unsuitable for cultivation or improved pasture. Douglas-fir, hemlock, and cedar grow on these soils. Because slopes are steep, very little, if any, woodland management can be applied.

CAPABILITY UNIT VIIs-1

This unit consists of shallow and moderately deep, stony, well-drained to excessively drained soils of the Kilchis and Klickitat series. Slopes are 60 to 90 percent. Annual precipitation is 80 to 120 inches, and the frost-free season is 145 to 200 days. These soils have very low and low fertility. The available water capacity ranges from 2 to 4 inches. Permeability is moderately rapid or moderate, surface runoff is rapid, and the erosion hazard severe in unprotected areas.

These soils are used as woodland. The steep slopes and stoniness make them unsuitable for cultivation or improved pasture. Douglas-fir and hemlock grow on these soils. Production is low because of prolonged dryness. Because slopes are steep, very little, if any, woodland management can be applied.

CAPABILITY UNIT VIIw-1

This unit consists of Fresh water marsh that contains a variety of soil material and rock fragments mixed with roots, tree limbs, and other material. It occurs on very poorly drained bottom lands in the Coast Range. Water stands at, or near, the surface all year. Surface runoff is very slow. Reaction is very strongly acid. Annual precipitation is 80 to 110 inches, and the frost-free season is 145 to 200 days.

This land type has limited use for wildlife habitat.

Predicted Yields and Management by Crop

The yield estimates for this survey are based on observations made by the soil scientists who surveyed the Area, and by State and Federal farm advisors of the Extension Service, Soil Conservation Service, and the Agricultural Experiment Station. Federal and county census data were also reviewed and considered. More information was available for some soils than for others. Where little or no information was available for a soil, predictions were made by comparison with similar soils.

No estimates are given for soils on which the particular crop is not generally grown or for soils to which the crop is not suited.

Table 2 gives the yields of the principal crops grown in the Area under a high level of management.

Several important limitations should be kept in mind when using the yield estimates in table 2. The figures are estimates or predictions of average yields that may be expected over a period of years. In any given year, the yield may be considerably higher or lower than the average. There is considerable variation within some soils, as for example, variation in depth to claypan or bedrock, and this was considered in making the estimates. New developments in crop breeding, control of insects and diseases, fertilizers, tillage, irrigation, and drainage can change much of the information on management, although the yields obtainable may not change greatly. Newer and better practices can always be substituted, and the State and Federal agricultural agencies are always ready to provide the latest information available.

Predictions or estimates of yields are useful if the management is described through which such yields were obtained. In the pages that follow, management is described for each crop named in table 2 when that crop is grown on soils of a specified capability unit. All the soils in a capability unit require about the same management for a specified crop.

All requirements for plant nutrients are given for the elemental form; for example, the amount of the element phosphorus needed per acre is given. Recommendations for fertilizer and for use of amendments are given in the "Oregon State University Fertilizer Guides" for various crops. These fertilizer guides are revised as new information becomes available for a particular crop. The gross irrigation requirement is the total amount of water per acre needed annually by the plant, less the average effective precipitation. The irrigation requirement is calculated on the assumption that the irrigation system is 70 percent efficient.

Dryland winter wheat

For the purpose of describing management of dryland winter wheat, soils of the survey area are divided into six groups. Management needed for soils in group 1 is described. The management needed for soils in groups 2 through 5 is similar to that described for group 1, except that additional practices may be needed or different specifications for fertilizer and lime may be required. These variations in management from that shown for group 1 are described for each subsequent group of soils. Soils in group 6 are not suited to dryland winter wheat. Therefore, management for soils of that group is not given.

Group 1.-This group consists of soils of capability units I-1, IIe-2, and IIs-1. For these soils a commonly used cropping system is 2 years of wheat and 2 years of red clover. Preparation of the seedbed consists of diskplowing two or three times and of harrowing two or three times. Good varieties for planting are Dru Champ and Nugaines. Seed is drilled at a rate of 100 pounds per acre.

Fertilization consists of applying 30 pounds of nitrogen per acre in fall, and 90 to 100 pounds per acre in March. Phosphorus and potassium are applied in fall according to needs indicated by the results of soil tests. When soil reaction drops below 5.5, lime is applied at the rate of 2 or 3 tons per acre for the legume included in the cropping system. About 20 to 30 pounds of sulfur generally is needed.

The type of herbicide to apply for weed control is determined by the kind and degree of infestation. Applying herbicides in fall helps control annual grasses. Applying herbicides in spring helps control broadleaf weeds. Harvesting is done by combine. Use of crop residue is a good conservation practice.

Group 2.-In this group are soils of capability units IIw-2 and IIw-6. Tile drainage is the only additional practice needed.

Group 3.-In this group are soils of capability units IIe-1, IIe-3, IIe-4, IIw-4, IIIe-1, IIIe-2, IIIe-4, IIIe-5, IIIe-6, IVe-1, IVe-3, and IVe-4. Additional practices needed are cross-slope farming and establishing grassed waterways.

Group 4.-In this group are soils of capability unit IVe-2. Additional practices needed are establishing grassed waterways and field stripcropping or diversions.

Group 5.-Wapato silty clay loam, in capability unit IIIw-5, is the only soil in this group. Tile drainage and subsoiling are additional practices needed.

Group 6.-In this group are soils of capability units IIw-1, IIw-3, IIw-5, IIIe-3, IIIw-1, IIIw-2, IIIw-3, IIIw-4, IVw-1, IVw-2, IVw-3, VIe-1, VIe-2, VIe-3, VIe-4, VIe-5, VIw-1, VIs-1, VIIe-1, VIIs-1, and VIIIw-

[2] LOUIE H. GROSS, HUGH HICKERSON, and W. WAYNE ROBERTS, Yamhill County extension agents, helped prepare this section.

1. These soils are too wet, too steep, too stony, or too shallow to cultivate, or are otherwise unsuited to winter wheat.

Dryland spring barley

For the purpose of describing management of dryland spring barley, soils of the survey area are divided into eight groups. Management needed for soils in group 1 is described. The management needed for soils in groups 2 through 7 is similar to that described for group 1, except that additional practices may be needed or different specifications for fertilizer and lime may be required. These variations in management from that shown for group 1 are described for each subsequent group of soils. Soils in group 8 are not suited to dryland spring barley. Therefore, management for soils of that group is not given.

Group 1.-This group consists of soils of capability units I-1, IIe-2, and IIs-1. A commonly used cropping system for these soils is 2 years of grain and 4 years of grasses and legumes. Preparation of the seedbed consists of plowing in fall, diskplowing two or three times in March, harrowing two or three times, and cultipacking. A good variety for planting is Hannchen. Seed is drilled at a rate of 100 pounds per row during the first half of April. Rows are 7 inches wide.

Fertilization consists of applying 40 pounds of nitrogen per acre, 40 pounds of phosphorus per acre, and 40 pounds of potassium per acre banded 1 inch from the seed. Lime is applied at the rate of 1 to 3 tons per acre and sulfur at 20 to 30 pounds per acre for the legume included in the cropping system.

Applying herbicides in spring helps control broadleaf weeds and annual grasses. Harvesting is done by combine. Use of crop residue is a good conservation practice.

Group 2.-In this group are soils of capability units IIw-1, IIw-3, and IIw-5. Growing a cover crop in winter and maintaining permanent cover or standing residue in overflow channels are the only additional practices needed.

Group 3.-In this group are soils of capability units IIe-1, IIe-3, IIe-4, IIw-4, IIIe-3, IIIe-4, and IIIe-6. Cross-slope farming or growing a cover crop in winter and establishing grassed waterways are the only additional practices needed.

Group 4.-In this group are soils of capability units IIIe-1, IIIe-2, IIIe-5, IVe-1, IVe-3, and IVe-4. Additional practices needed are cross-slope farming, growing a cover crop in winter, grassing waterways, and rough tillage. About 2 to 3 tons of lime are needed medium,

Group 5.-Only the soils of capability unit IVe-2 are in this group. Additional practices needed are grassing waterways and rough tillage, field stripcropping, and establishing diversion terraces.

Group 6.-In this group are the soils of capability units IIIw-1, IIIw-2, IIIw-3, IIIw-4, IVw-1, IVw-2 and IVw-3. Additional practices needed are drainage using tile or open ditches and subsoiling.

Group 7.-ln this group are the soils of capability units IIw-2, IIw-6, and IIIw-5. The only additional practice needed is tile drainage.

Group 8.-In this group are the soils of capability units VIe-1, VIe-2, VIe-3, VIe-4, VIe-5, VIw-1, VIs-1, VIIe-1, VIIs-1, and VIIIw-1. These soils are too wet, too steep, too stony, or too shallow to cultivate or are otherwise unsuited to spring barley.

Dryland alfalfa

For the purpose of describing management of dryland alfalfa, soils of the survey area are divided into eight groups. Management needed for soils in group 1 is described. The management needed for soils in groups 2 through 7 is similar to that described for group 1, except that additional practices may be needed or different specifications for fertilizer and lime may be required. These variations in management from that shown for group 1 are described for each subsequent group of soils. Soils in group 8 are not suited to dryland alfalfa. Therefore, management for soils of that group is not given.

Group 1.-This group consists of soils of capability units I-1, IIe-2, and IIs-1. A commonly used cropping system for these soils is 4 or 5 years of alfalfa and 2 years of winter wheat in conjunction with crimson clover in the fall, as green manure. Preparation of the seedbed consists of diskplowing two to five times, harrowing two to five times, and cultipacking. A good variety for planting is DuPuits, Flemish type. The seed is drilled at a rate of 10 to 15 pounds per acre between April 15 and May 15.

Fertilization consists of applying 30 to 40 pounds of sulfur per acre, potassium and phosphorus according to soil tests, and boron at a rate of 2 or 3 pounds per acre. Lime is applied at the rate of 1 to 3 tons per acre when soil reaction drops below pH 6.0.

Clipping and applying herbicides help control weeds. Herbicides are applied on established stands in October. Harvesting involves mowing, conditioning, raking, and baling, or making silage out of the first cutting and hay out of the second and third cuttings. Cutting at one-quarter bloom stage insures maximum quality.

Group 2.-In this group are soils of capability units IIw-1 and IIw-3. Spring planting and maintaining permanent cover in overflow channels are the only additional practices needed.

Group 3.-Only the soils of capability unit IIw-5 are in this group. Maintaining permanent cover in overflow channels, planting in spring (May 15 to June 15), and installing tile drains are the only additional practices needed.

Group 4.-In this group are soils of capability units IIe-1, IIe-3, IIIe-1, IIIe-2, IIIe-4, and IVe-1. Additional practices needed are cross-slope farming or growing a cover crop in winter and grassing waterways. Growing a cover crop of small grain in winter is needed for fall-seeded alfalfa. About 2 to 5 tons of lime are needed per acre.

Group 5.-In this group are the soils of capability units IIe-4, IIIe-5, IIIe-6, and IVe-4. Additional practices needed are cross-slope farming or growing cover in winter and grassing waterways. Where growing fall-seeded alfalfa, a winter cover crop of small grain is needed. About 2 to 4 tons of lime are needed per acre. Installing tile drains is also necessary.

Group 6.-In this group are the soils of capability units IIw-2, IIw-4, and IIw-6. Additional practices needed are drainage using tile.

Group 7.-Only the soils of capability unit IVe-2 are in this group. Additional practices needed are grassing waterways, field stripcropping, and establishing diversion terraces. Where fall-seeded alfalfa is grown, a winter cover crop of small grain is needed. About 2 to 4 tons of lime are needed per acre.

Group 8.-In this group are the soils of capability units IIIe-3, IIIw-1, IIIw-2, IIIw-3, IIIw-4, IIIw-5, IVe-3, IVw-1, IVw-2, IVw-3, VIe-1, VIe-2, VIe-3, VIe-4, VIe-5, VIw-1, VIs-1, VIIe-1, VIIs-1, and VIIIw-1. These soils are too wet, too steep, too stony, or too shallow to cultivate or are otherwise unsuited to dryland alfalfa.

Dryland bentgrass for seed

For the purpose of describing management of dryland bentgrass for seed, soils of the survey area are divided into six groups. Management needed for soils in group 1 is described. The management needed for soils in groups 2 through 5 is similar to that described for group 1, except that additional practices may be needed or different specifications for fertilizer and lime may be required. These variations in management from that shown for group 1 are described for each subsequent group of soils. Soils in group 6 are not suited to dryland bentgrass for seed. Therefore, management for soils of that group is not given.

Group 1.-This group consists of soils of capability units I-1, IIe-2, IIw-2, IIw-6, and IIs-1. A fine seedbed is necessary to establish a stand of bentgrass. Preparation of the seedbed consists of rough plowing, diskplowing, harrowing, and rolling. A good variety for planting is Highland or Astoria. Seed is drilled at a rate of 3 pounds per acre between May 15 and June 15, or in the fall.

Fertilization consists of applying, in the fall, 20 pounds of nitrogen per acre, 40 to 60 pounds of phosphorus per acre, potassium as required by soil test, and 10 to 15 pounds of sulfur. Adding 70 to 90 pounds of nitrogen per acre in the spring is also required.

Applying herbicides in fall and in spring helps control weeds. Burning in the fall helps control nematodes. Harvesting is done by combine.

Group 2.-In this group are soils of capability units IIw-1, IIw-3, and IIw-5. Planting in spring (May 15 to June 15) and maintaining permanent cover in overflow channels are the only additional practices needed.

Group 3.-In this group are soils of capability units IIe-1, IIe-3, IIe-4, IIw-4, IIIe-1, IIIe-2, IIIe-3, IIIe-4, IIIe-5, IIIe-6, IVe-1, IVe-2, IVe-3, and IVe-4. Cross-slope farming, growing a cover in winter of small grain for fall-seeded grass, and establishing grassed waterways are the only additional practices needed.

Group 4.-In this group are soils of capability units IIIw-1, IIIw-4, and IVw-1. The only additional practice needed is installing tile drains.

Group 5.-In this group are soils of capability units IIIw-2, IIIw-3, IIIw-5, IVw-2, and IVw-3. Additional practices needed are planting in spring (May 15 to June 15), maintaining permanent cover in overflow channels, and installing tile drains.

Group 6.-In this group are the soils of capability units VIe-1, VIe-2, VIe-3, VIe-4, VIe-5, VIw-1, VIs-1, VIIe-1, VIIs-1, and VIIIw-1. These soils are too wet, too steep, too stony, or too shallow to cultivate or are otherwise unsuited to bentgrass.

Dryland plum trees

For the purpose of describing management of dryland plum trees, soils of the survey area are divided into nine groups. Management needed for soils in group 1 is described. The management needed for soils in groups 2 through 8 is similar to that described for group 1, except that additional practices may be needed or different specifications for fertilizer and lime may be required. These variations in management from that shown for group 1 are described for each subsequent group of soils. Soils in group 9 are not suited to dryland plum trees. Therefore, management for soils of that group is not given.

Group 1.-This group consists of soils of capability units I-1, IIe-3, IIe-4, and IIs-1. Preparation for tree planting consists of diskplowing two or three times and harrowing one or two times. A good variety for planting is Italian or Brooks. Tree planting is done late in fall or early in spring at a spacing of 20 feet by 20 feet, amounting to 100 trees per acre.

Fertilization consists of applying 1 pound of nitrogen and 0.1 pound of boron per tree. Lime is applied at the rate of 1 ton per acre for legumes in the green manure crop. Cultivating is done to a depth of less than 3 or 4 inches.

Systematic pruning is practiced. Controlling weeds is done by summer fallow and spraying. Harvesting is done by mechanical shaking and gathering the fruit off the ground by hand.

Group 2.-In this group are soils of capability units IIw-1 and IIw-3. Growing a cover crop in winter and maintaining permanent cover in overflow channels are the only additional practices needed.

Group 3.-Only the soils of capability unit IIe-1 are in this group. Cross-slope farming and rough tillage or growing a cover in winter are the only additional practices needed.

Group 4.-In this group are soils of capability units IIIe-1, IIIe-2, IIIe-4, IIIe-5, and IVe-1. Additional practices needed are cross-slope farming, growing a cover crop in winter, and grassing waterways.

Group 5.-Only the soils of capability unit IVe-2 are in this group. Additional practices needed are grassing waterways and contour planting with winter cover.

Group 6.-In this group are the soils of capability units IIw-2 and IIw-6. The only additional practice needed is tile drainage.

Group 7.-In this group are soils of capability units IIw-4, IIIe-6, and IVe-4. Additional practices needed are cross-slope farming, growing a cover crop in winter, and installing tile drains.

Group 8.-Only the soils of capability unit IIw-5 are in this group. Additional practices needed are growing a cover crop in winter, maintaining permanent cover in overflow channels, and installing tile drains.

Group 9.-In this group are the soils of capability units IIe-2, IIIe-3 IIIw-1, IIIw-2, IIIw-3, IIIw-4, IIIw-5, IVe-3, IVw-1, IVw-2, IVw-3, VIe-1, VIe-2, VIe-3, VIe-4, VIe-5, VIw-1, VIs-1, VIIe-1, VIIs-1, and VIIIw-1. These

soils are too wet, too steep, too stony, or too shallow to cultivate or are otherwise unsuited to plum trees.

Dryland walnut trees

For the purpose of describing management of dryland walnut trees, soils of the survey area are divided into nine groups. Management needed for soils in group 1 is described. The management needed for soils in groups 2 through 8 is similar to that described for group 1, except that additional practices may be needed or different specifications for fertilizer and lime may be required. These variations in management from that shown for group 1 are described for each subsequent group of soils. Soils in group 9 are not suited to dryland walnut trees. Therefore, management for soils of that group is not given.

Group 1-This group consists of soils of capability units I-1, IIe-3, and IIe-4. Preparation for tree planting consists of plowing, diskplowing two or three times, and harrowing one or two times. A good variety for planting is Franquette or Hartley. Trees are planted from late in fall to early March at a permanent spacing of 50 feet by 50 feet, amounting to 16 trees per acre. Filler trees are interplanted so that, within each row there is a tree every 25 feet, and the rows are 50 feet apart. Within 25 years the filler trees are removed.

Fertilization consists of applying 1 pound of nitrogen and 1 pound of boron per tree for trees 5 to 10 years old, 2 to 4: pounds of nitrogen and 2 to 3 pounds of boron for trees 10 to 20 years old, and 6 pounds of nitrogen and 4 to 5 pounds of boron every other year for trees more than 20 years old. Lime is applied at a rate of 1 ton for the legumes in the green-manure crop.

Cultivating is done to a depth of less than 3 or 4 inches by May 10. Systematic pruning is practiced. Controlling weeds is done by summer fallow and spraying as required. Controlling disease generally involves spraying or dusting for blight Fertilization of the green manure crop is a good conservation practice. Harvesting is done by gathering the walnuts off the ground by hand.

Group 2-In this group are soils of capability units IIw-1 and IIw-3. Growing a cover crop in winter and maintaining permanent cover in overflow channels are the only additional practices needed.

Group 3.-Only the soils of capability unit IIe-1 are in this group. Cross-slope farming and rough tillage or growing a cover in winter are the only additional practices needed.

Group 4-In this group are soils of capability units IIIe-1, IIIe-2, and IIIe-5. Additional practices needed are cross-slope farming, growing a cover crop in winter, and grassing waterways.

Group 5-Only the soils of capability unit IVe-2 are in this group. Additional practices needed are grassing waterways, contour planting, and growing a cover crop in winter.

Group 6.-In this group are the soils of capability units IIw-2 and IIw-6. The only additional practice needed is tile drainage.

Group 7.-In this group are soils of capability units IIw-4, IIIe-6, and IVe-4. Additional practices needed are cross-slope farming, growing a cover crop in -winter, and tile drainage.

Group 8.-Only the soils of capability unit IIw-5 are in this group. Additional practices needed are growing a cover crop in winter, maintaining permanent cover in overflow channels, and tile drainage.

Group 9.-In this group are the soils of capability units IIe-2, IIIs-1, IIIe-3, IIIe-4, IIIw-2, IIIw-3, IIIw-4, IIIw-5, IVe-1, IVe-3, IVw-1, IVw-2, IVw-3, VIe-1, VIe-2, VIe-3, VIe-4, VIe-5, VIw-1, VIs-1, VIIe-1, VIIs-1, and VIIIw-1. These soils are too wet, too steep, too stony, or too shallow to cultivate or are otherwise unsuited to walnut trees.

Dryland red clover for seed

For the purpose of describing management of dryland red clover grown for seed, soils of the survey area are divided into eight groups. Management needed for soils in group 1 is described. The management needed for soils in groups 2 through 7 is similar to that described for group 1, except that additional practices may be needed or different specifications for fertilizer and lime may be required. These variations in management from that shown for group 1 are described for each subsequent group of soils. Soils in group 8 are not suited to dryland red clover. Therefore, management for soils of that group is not given.

Group 1-This group consists of soils of capability units I-1, IIe-3, and IIs-1. A commonly used cropping system for these soils is grain, clover, and one year of sweet corn. Seeding of clover is done in the spring using fall wheat or barley as a nurse crop. A good variety for planting is Kenland. Seed is drilled at a rate of 8 pounds per acre during March or April.

Fertilization consists of applying 20 to 30 pounds of sulfur per acre, and 2 pounds of boron per acre in the spring. When soil reaction drops below pH 5.5, lime is applied at the rate of 1 to 2 tons per acre for the legume included in the cropping system.

Applying insecticides when clover is in full bloom helps control insects. Applying herbicides in fall helps control weeds. Harvesting is done by combine where standing or in windrows.

Group 2-In this group are soils of capability units IIw-1 and IIw-3. Growing a cover crop in winter and maintaining permanent cover in overflow channels are the only additional practices needed.

Group 3-Only the soils of capability unit IIw-5 are in this group. Additional practices needed are growing a cover crop in winter, maintaining permanent cover in overflow channels, and tile drainage.

Group 4.-In this group are soils of capability units IIe-1, IIe-3, IIIe-1, IIIe-2, IIIe-4, IVe-1 and IVe-3. Additional practices needed are cross-slope farming or growing a cover crop in winter, and grassing waterways. About 2 to 3 tons of lime are needed per acre.

Group 5.-In this group are soils of capability units IIe-4, IIIe-5, IIIe-6, and IVe-4. Additional practices needed are grassing waterways, cross-slope farming or growing a cover crop in winter, and tile drainage. About 2 to 3 tons of lime are needed per acre.

Group 6.-In this group are the soils of capability units IIw-2, IIw-4, and IIw-6. The only additional practice needed is tile drainage.

Group 7.-Only the soils of capability unit IVe-2 are in this group. Additional practices needed are grassing waterway diversions or field stripcropping. About 2 to 3 tons of lime are needed per acre.

Group 8.-In this group are the soils of capability units IIIe-3, IIIw-1, IIIw-2, IIIw-3, IIIw-4, IIIw-5, IVw-1, IVw-2, IVw-3, VIe-1, VIe-2, VIe-3, VIe-4, VIe-5, VIw-1, VIs-1, VIIe-1, VIIs-1, and VIIIw-1. These soils are too wet, too steep, too stony, or too shallow to cultivate or are otherwise unsuited to red clover.

Irrigated pasture

For the purpose of describing management of irrigated pasture, soils of the survey area are divided into eight groups. Management needed for soils in group 1 is described. The management needed for soils in groups 2 through 7 is similar to that described for group 1, except that additional practices may be needed or different specifications for fertilizer and lime may be required. These variations in management from that shown for group 1 are described for each subsequent group of soils. Soils in group 8 are not suited to irrigated pasture. Therefore, management for soils of that group is not given.

Group 1.-This group consists of capability units I-1, IIs-1, and IIe-2. A commonly used cropping system for these soils is 2 years of small grain and 6 years of pasture. Preparation of the necessary fine seedbed consists of plowing, diskplowing two to five times, harrowing two to five times, and cultipacking. Suitable seeding mixtures are 10 pounds of latar orchardgrass and 2 pounds of New Zealand white clover, or 12 pounds of alta fescue and 2 pounds of New Zealand white clover. Suitable planting dates are April 15 to June 1 and August 15 to September 30.

Fertilization consists of applying phosphorus and potassium according to soil tests, nitrogen at a rate of 30 pounds per acre, sulfur at a rate of 20 to 30 pounds per acre, and boron at a rate of 2 or 3 pounds per acre. Once the pasture is established, annual applications are 50 pounds of nitrogen per acre, 20 to 30 pounds of sulfur per acre, and 2 to 3 pounds of boron per acre applied late in February or early in March, followed by 30 to 40 pounds of additional nitrogen applied late in August. Phosphorus can be applied in the fall at a rate of 100 pounds per acre. Liming is at a rate of 1 to 3 tons per acre.

Controlling weeds involves clipping 3 or 4 times per season and spot spraying with herbicide. Dung is spread 3 or 4 times per season with a spike-tooth harrow.

Irrigating is by sprinkler, and involves good water management such as proper timing, proper rate of application and distribution, and use of moisture blocks. The gross irrigation water requirement is about 29 inches from June 1 to September 20. Managing pasture includes dividing fields to provide 1 day of grazing per field or green chopping and feeding in a dry lot. Twenty-four to thirty days are adequate for regrowth when not grazed and while being irrigated. The season of use is April through October.

Group 2.-In this group are soils of capability units IIw-1, IIw-3, and IIw-5. Spring planting (May 15 to June 15) and maintaining permanent cover in overflow channels are the only additional practices needed.

Group 3.-In this group are soils of capability units IIe-1, IIe-3, and IIe-4. Cross-slope farming and establishing grassed waterways are the only additional practices needed.

Group 4.-In this group are soils of capability units IIw-4 and IIIe-3. Additional practices needed are cross-slope farming, grassing waterways, and tile drainage.

Group 5.-In this group are soils of capability units IIIe-1, IIIe-2, IIIe-4, IIIe-5, IIIe-6, IVe-1, IVe-2, IVe-3, and IVe-4. Additional practices needed are cross-slope farming, grassing waterways, and spring planting (April 15 to May 15).

Group 6.-In this group are soils of capability units IIIw-1, IIIw-2, IIIw-3, IIIw-4, IIIw-5, IVw-1, IVw-2, and IVw-3. Additional practices needed are tile drainage, planting in June or during the period August 15 to September 15, and seeding 10 pounds of meadow foxtail, or 5 pounds of meadow foxtail and 8 pounds of alta fescue, or 6 pounds of meadow foxtail and 2 pounds of New Zealand white clover.

Group 7. In this group are the soils of capability units IIw-2 and IIw-6. The only additional practice needed is tile drainage.

Group 8.-In this group are the soils of capability units VIe-1, VIe-2, VIe-3, VIe-4, VIe-5, VIw-1, VIs-1, VIIe-1, VIIs-1, and VIIIw-1. These soils are too wet, too steep, too stony, or too shallow to cultivate or are otherwise unsuited to irrigated pasture.

Irrigated strawberries

For the purpose of describing management of irrigated strawberries, soils of the survey area are divided into six groups. Management needed for soils in group 1 is described. The management needed for soils in groups 2 through 5 is similar to that described for group 1, except that additional practices may be needed or different specifications for fertilizer and lime may be required. These variations in management from that shown for group 1 are described for each subsequent group of soils. Soils in group 6 are not suited to irrigated strawberries. Therefore, management for soils of that group is not given.

Group 1.-This group consists of soils of capability units I-1 and IIs-1. A commonly used cropping system for these soils is 4 or 5 years of berries, 4 or 5 years of grass and legume and 1 year of spring grain or row crop. Preparation of the seedbed consists of plowing, diskplowing two or three times, harrowing two or three times, subsoiling in the fall, and rolling. A good variety for planting is Certified Northwest. Planting is done by machine in April or May. Spacing between plants is 12 to 15 inches, and spacing between rows is 42 inches. Hand hoeing and cultivating 2 to 4 times are needed. Controlling runners and mowing tops aid in sanitation and harvesting. Subsoiling between rows is necessary about August 1.

Fertilization consists of applying 40 to 50 pounds of nitrogen per acre, 60 to 80 pounds of phosphorus per acre, 40 to 60 pounds of potassium per acre, 15 to 20 pounds of sulfur per acre, 1 to 2 pounds of boron per acre, and a side dressing of 20 to 30 pounds of nitrogen per acre in

August. After establishment of the crop, annual rates are 50 to 60 pounds of nitrogen per acre, 80 to 90 pounds of phosphorus per acre, 70 to 90 pounds of potassium per acre, 15 to 20 pounds of sulfur per acre, and I pound of boron per acre. Lime is applied at the rate of 1 to 2 tons of lime per acre for the legume in the cropping system.

Applying herbicides in fall helps control weeds. Applying soil insecticides helps control root weevil. Spraying is done 5 or 6 times to help control insects and dis eases in spring and summer.

Irrigating is done by sprinkler and requires good water management such as proper timing, proper rate of application and distribution, and use of moisture blocks. Maintaining moisture at 75 percent of field capacity improves the yield and quality of the crop. The gross irrigation water requirement is about 14 inches. Harvesting requires about 4 or 5 pickings by hand.

Group 2.-In this group are soils of capability units IIw-2 and IIw-6. Additional practices are tile drainage and planting a variety like Siletz.

Group 3.-In this group are soils of capability units IIe-1, IIe-3, IIIe-1, IIIe-2, IIIe-4, and IVe-1. Additional practices needed are cross-slope farming, rough tillage, and grassing waterways, or growing a cover crop in winter and grassing waterways.

Group 4.-In this group are soils of capability units IIe-4, IIw-4, IIIe-5, IIIe-6, and IVe-4. Additional practices needed are cross-slope farming, rough tillage, and grassing waterways, or growing a cover crop in winter, grassing waterways, and tile drainage.

Group 5.-Only the soils of capability unit IVe-2 are in this group. Additional practices needed are grassing waterways and growing a. cover crop in winter, rough tillage, and field stripcropping.

Group 6.-Is this group are the soils of capability units IIe-2, IIw-1, IIw-3, IIw-5, IIIe-3, IIIw-1, IIIw-2, IIIw-3, IIIw-4, IIIw-5, IVe-3, IVw-1, IVw-2, IVw-3, VIe-1, VIe-2, VIe-3, VIe-4, VIe-5, VIw-1, VIs-1, VIIe-1, VIIs-1, and VIIIw-1. These soils are too wet, too steep, too stony, or too shallow to cultivate or are otherwise unsuited to irrigated strawberries.

Irrigated blackberries

For the purpose of describing management of irrigated blackberries, soils of the survey area are divided into six groups. Management needed for soils in group 1 is described. The management needed for soils in groups 2 through 5 is similar to that described for group 1, except that additional practices may be needed or different specifications for fertilizer and lime may be required. These variations in management from that shown for group 1 are described for each subsequent group of soils. Soils in group 6 are not suited to irrigated blackberries. Therefore, management for soils of that group is not given.

Group 1-This group consists of soils of capability units I-1 IIe-2, IIw-6, and IIs-1. A commonly used cropping system for these soils is continuous blackberries for at least 10 years and an annual legume or small grain for a green manure crop. Preparation of the seedbed consists of diskplowing 3 times, harrowing 3 times, soil fumigation, and application of insecticide prior to planting in order to control wireworms and root weevils.

Planting is done by hand. Spacing is 10 feet between rows and 5 feet between plants.

Fertilization consists of applying 80 to 100 pounds of nitrogen per acre, 80 pounds of phosphorus per acre, 80 pounds of potassium per acre, and 2 to 3 pounds of boron per acre. A good variety for planting is Thornless Evergreen planted between March 15 and April 15.

Cultivating 3 or 4 times, hand hoeing once, using herbicide in fall and spring, and spot spraying help control weeds.

Cultural practices consist of pruning, clipping, training vines, use of two wires, and use of insecticide spray.

Irrigating is done by sprinkler and requires good water management, such as proper timing, proper rate of application and distribution, and use of moisture blocks. Gross irrigation water requirement is about 16 inches. Harvesting is mainly by machine, but band picking is done in places. Subsoiling once to a depth of 18 or 20 inches at the center line of each row is a good conservation practice.

Group 2.-In this group are soils of capability units IIw-1 and IIw-3. Growing a cover crop in winter and maintaining permanent cover in overflow channels are the only additional practices needed.

Group 3.-In this group are soils of capability units IIe-1, IIe-3, IIe-4, IIw-4, and IIIe-4. Cross-slope farming or growing a cover crop in winter and establishing grassed waterways are the only additional practices needed.

Group 4.-In this group are soils of capability units IIIe-1, IIIe-2, IIIe-5, IIIe-6, IVe-1, and IVe-4. Additional practices needed are cross-slope farming, rough tillage, and grassing waterways or growing a cover crop in winter and grassing waterways.

Group 5.-In this group are the soils of capability units IIw-2, IIw-5, IIIw-1, IIIw-2, IIIw-4, IIIw-5, IVw-1, and IVw-3. The only additional practices needed are tile drainage and subsoiling.

Group 6.-In this group are the soils of capability units IIIe-3, IIIw-3, IVe-2, IVe-3, IVw-2, VIe-1, VIe-2, VIe-3, VIe-4, VIe-5, VIw-1, VIs-1, VIIe-1, VIIs-1, and VIII-w-1. These soils are too wet, too steep, too stony, or too shallow to cultivate or are otherwise unsuited to irrigated blackberries.

Irrigated pole beans

For the purpose of describing management of irrigated pole beans, soils of the survey area are divided into seven groups. Management needed for soils in group 1 is described. The management needed for soils in groups 2 through 6 is similar to that described for group 1, except that additional practices may be needed or different specifications for fertilizer and lime may be required. These variations in management from that shown for group 1 are described for each subsequent group of soils. Soils in group 7 are not suited to irrigated pole beans. Therefore, management for soils of that group is not given.

Group 1.-This group consists of soils of capability units I-1, IIw-2, IIw-6, and IIs-1. A commonly used cropping system for these soils is continuous beans and an annual green manure crop of small grain or a legume. Preparation of the seedbed consists of diskplowing 2

or 3 times, harrowing 1 or 2 times, and rolling. Planting of a good variety such as Blue Lake can be done between May 1 and June 15 using 25 to 30 pounds of treated seed.

Fertilization consists of applying 200 pounds of nitrogen per acre as a split application, 150 pounds of phosphorus per acre, 75 to 100 pounds of potassium per acre, and 20 to 30 pounds of sulfur per acre applied by broadcasting, by row, or in irrigation water. Lime is applied at the rate, of 1 to 2 tons per acre.

Applying pre-emergence spray, cultivating 3 or 4 times, and hand hoeing help control weeds. Cultural practices include stringing and training of vines. Timely applications of fungicides and insecticides are necessary to control pests and diseases.

Irrigating is done by sprinkler and requires good water management such as proper timing, proper rate of application and distribution, and use of moisture blocks. The gross irrigation water requirement is about 18 inches. Harvesting involves hand picking every 5 or 6 days totaling 5 to 8 times. Post harvest practices include the cutting and removal of vines, removal of temporary stakes, and disking twice. Use of crop residue is a good conservation practice.

Group 2.-In this group are soils of capability units IIw-1, IIw-3, and IIw-5. Growing a cover crop in winter and maintaining permanent cover in overflow channels are the only additional practices needed.

Group 3.-In this group are soils of capability units IIe-1, IIe-3, IIe-4, and IIw-4. Additional practices needed are cross-slope farming or growing a cover crop in winter and establishing grassed waterways. About 2 to 3 tons of lime are needed per acre.

Group 4.-In this group are soils of capability units IIIe-1, IIIe-2, IIIe-6, and IVe-4. Additional practices needed are cross-slope farming, growing a cover crop in winter, and grassing waterways. About 2 to 3 tons of lime are needed per acre.

Group 5-Only the soils of capability unit IIIw-1 are in this group. The only additional practice needed is tile drainage.

Group 6.-In this group are soils of capability units IIIw-3, and IIw-5. Additional practices needed are growing a cover crop in winter, maintaining permanent cover in overflow channels, and tile drainage.

Group 7.-Capability units IIe-2, IIIe-3, IIIe-4, IIIw-4, IVe-1, IVe-3, TV-,v-1, IVw-2, IVw-3, Vle-1, VIe-2, VIe-3, VIe-4, VIe-5, VI-w-1, VIs-1, VIIe-1, VIIs-1, and VIIIw-1. These soils are, too wet, too steep, too stony, or too shallow to cultivate, or are otherwise unsuited to irrigated pole beans.

Irrigated sweet corn

For the purpose of describing management of irrigated sweet corn, soils of the survey area are divided into five groups. Management needed for soils in group 1 is described. The, management needed for soils in groups 2 through 4 is similar to that described for group 1, except that additional practices may be needed or different specifications for fertilizer and lime may be required. These variations in management from that shown for group 1 are described for each subsequent group of soils. Soils in group 5 are not suited to irrigated sweet corn. Therefore, management for soils of that group is not given.

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Group 1.-This group consists of soils of capability units I-1, IIw-2, IIw-6, and IIs-1. A commonly used cropping system for these soils is 2 years of sweet corn and green manure, 1 year of beans and green manure, 1 year of small grain, and 2 years of red clover. Preparation of the seedbed consists of diskplowing 3 or 4 times, harrowing 3 or 4 times, rolling, and pre-planting with a soil insecticide. Planting is done with a corn planter at the rate of 8 to 10 pounds of FM-Cross or Jubilee per acre during the period May 1 to June 15.

Fertilization consists of applying 120 to 200 pounds of nitrogen per acre, in a split application, 80 to 125 pounds of phosphorus per acre, 60 to 100 pounds of potassium per acre, as a side dressing, and 15 to 20 pounds of sulfur per acre. Lime is applied at the rate of 1 to 2 tons per acre for the legume included in the cropping system.

Applying a pre-emergence spray and cultivating 1 or 2 times as needed helps control weeds. Cultural practices include use of insecticides if needed.

Irrigating is done by sprinkler. The gross water requirement is about 20 inches. Harvesting is done by machine. Use of crop residue is a good conservation practice.

Group 2.-In this group are soils of capability units IIw-1, IIw-3, and IIw-5. Additional practices needed are growing a cover crop in winter or letting cornstalks stand and maintaining permanent cover in overflow channels.

Group 3.-In this group are soils of capability units IIe-1, IIe-3, IIe-4, IIw-4, IIIe-1, IIIe-2, IIIe-5, IIIe-6, and IVe-4. Additional practices needed are cross-slope farming, rough tillage, and grassing waterways. About 2 to 3 tons of lime are needed per acre.

Group 4.-In this group are soils of capability units IIIw-1, IIIw-2, IIIw-3, IIIw-5, IVw-1, IVw-2, and IVw-3. The only additional practice needed is tile drainage.

Group 5.-In this group are soils of capability units IIe-2, IIIe-3, IIIe-4, IIIw-4, IVe-1, IVe-2, IVe-3, VIe-1, VIe-2, VIe-3, VIe-4, VIe-5, VIw-1, VIs-1, VIIe-1, VIIs-4, and VIIIw-1. These soils are too wet, too steep, too stony, or too shallow to cultivate, or are otherwise unsuited to irrigated sweet corn.

Use of the Soils as Woodland [3]

This part of the soil survey contains interpretations for use and management of soils of the survey area as woodland. Subjects that are discussed are the occurrence of native species of trees, the vegetation in the understory, site index for Douglas-fir, natural competition from undesirable plants, mortality of tree seedlings, limitations on the use of heavy equipment, and hazards of erosion and windthrow. Also discussed are the management and harvest of special woodland products.

Historically, the broad valley floor was heavily timbered but interspersed with forest openings. Most of these openings were created by recurring fires, some of which may have been deliberately set by Indians in an effort to keep them clear. An early settler practice was to set fire to dry fern areas early in the spring to keep older burned

'WALTER M. FERGERSON, woodland specialist, Soil Conservation Service, helped prepare this section.

and logged areas free of brush and trees for use as pasture.

The Tillamook fire of 1933, and reburns of later years, covered several townships in the northwest corner of the county.

The valley floor was originally mainly covered with Douglas-fir or bottom-land hardwoods and western red-cedar, depending upon soil and drainage. The low foothills were in Douglas-fir and Oregon white oak, and there were some. natural grass openings on the south slopes. At elevations above 600 feet the forest consisted of Douglas-fir and varying amounts of alder, maple, and western hemlock, the latter increasing in density with elevation. Noble fir grow on the higher peaks.

Based on data from 1963 forest, statistics (11), there are 235,000 acres classed as commercial forest land in the survey area. The 23,000 acres of National Forest in Yamhill County is not included in the survey area. Ownership of the forest lands in the survey area is as follows: Public, other than National Forest, 43,000 acres; corporations, 90,000, farmers and private owners, 102,000.

Tree farms are well established and range in size, from privately owned tracts of 160 acres to industry-owned tracts of 30,000 acres. The management level is moderately high, and it includes reforestation of the harvested areas and a small amount of precommercial thinning, weeding, and intermediate harvest.

Douglas-fir is used for sawlogs, plywood, poles, and piling. Alder is used mainly to make furniture, and oak is used for fuel. Several sawmills are located in the county. There is one pulpmill in the county which depends on sawmill waste for its raw product. There is a demand for conifer boughs, huckleberry, and salal sprays, and swordfern fronds for floral greenery. Cascara bark is used for medicine. Hemlock and true firs are used for sawlogs and pulp.

Most mature and overmature forests have been harvested. As a result, most of the forested area is regrowth of even-aged stands as much as 70 years old. Many of the regrowth stands have also been harvested. The new stands of the Tillamook- Burn are less than 30 years old and not suited to site measurement.

Consequently, study plots for determining site quality were, located only on soil mapping units where a suitable stand of trees was available for measuring the heights of the trees and for evaluating other interpretative information. about the forests.

The heights of an equal number of dominant and co-dominant trees were measured. The heights of at least four trees were measured on each of 89 plots studied. The soils in each plot were identified and were described. Potential soil productivity was determined only for Douglas-fir, because that is the dominant species of tree in the survey area. Also, it is the only species in the survey area for which published yield tables are available (10).

Site class is a relative measure of a soil's wood-producing ability. Under this system the highest producing soil is designated as in site class 1, the lowest, as in site class 5. Soils in classes 2, 3, and 4 have intermediate wood-producing capacity. The grouping of soils into site classes is based on the average total height of the dominant and codominant trees in the stand at the age of 100 years. These are the larger trees whose crowns form the general level of the forest canopy and, in a few places, extend above it.

In the Yamhill Area, dominant and codominant trees growing in a well-stocked stand on soils of site class 1 will reach a height of 186 feet or more at the age of 100 years; those on soils of site class 2 will reach a height of 155 to 185 feet; those on soils of site class 3, heights of 125 to 155 feet; those on soils of site class 4, heights of 95 to 125 feet; and those on soils of site class 5, heights of less than 95 feet.

The average annual acre yield for unmanaged, fully stocked stands of Douglas-fir at the age of 100 years is shown in table 3. Data from this table and from the average site indexes shown in the descriptions of woodland suitability groups can be used by the landowner to determine the potential productivity of his soils for wood crops.

In the original manuscript,
there was a table in this space.
All tables have been updated
and are available as a separate document.

In many wooded areas, inadequate natural regeneration results in an understocked stand. Such a stand produces less wood per acre than is shown in table 3. Under improved management, natural regeneration is supplemented where needed, or it is replaced by planting and seeding, The resulting fully stocked stand is protected from fire, insects, and diseases. This level of management can be expected to produce wood in the quantities shown in table 3.

Under a high level of management, yields even higher than those shown in table 3 can be obtained. Under this level of management, fully stocked stands are not only protected from fire, insects, and diseases, but they are also thinned, fertilized, and improved through intermediate harvest cuttings. The trees may also be primed to improve the quality of the wood. Soils suited to a high

level of management generally have slopes of loss than 30 percent. They have moderate to high production potential and have few serious limitations to use as woodland. In this category are the soils in woodland groups 2cl, 2c2, 2ol, 2o2, 3c1, and 3f1.

Soils that have slopes of 30 to 60 percent increase the difficulty of applying a high level of management. Applying cultural practices and making harvest cuttings are extremely difficult. In this category are soils of woodland groups 2c3, 2r1, 2r2, 3c2, and 3f2. Soils that have slopes in excess of 60 percent restrict most management practices to those that call be applied by aerial methods. Soils in woodland groups 2r3 and 4fl and the very steep Astoria soil in 2c3 are in this category.

Five factors that affect suitability of a site for wood products are related to the soils. These factors are equipment limitations, plant competition, seedling mortality, and the hazards of windthrow and erosion. These factors are discussed for each group of soils under the heading "Woodland Groups."

Equipment limitations refer to those soil characteristics that restrict the use of logging equipment so that damage to the soils or trees will be prevented. Limitations are rated slight, moderate, or severe, according to the degree to which soil characteristics, such as slope, stoniness, and texture, influence the kind of equipment or the time of year the equipment can be used readily. The limitation is slight if the kind of equipment is not restricted, but the wet-season use of equipment is slightly restricted. It is moderate if slopes are steep but stable, or if slopes are gentle to steep but soils are stony enough to interfere with equipment use, or if soils are plastic and unstable when wet. The limitation is severe if many types of equipment cannot be used because of very steep slopes, or if equipment use is limited seasonally by very wet soils.

Plant competition refers to the invasion and rate of growth of undesirable plants on a soil when openings are made in the forest canopy. A slight limitation indicates that plant cornpetition will not prevent adequate natural regeneration and early growth of trees, nor will it interfere, with adequate development of planted seedlings. A moderate, limitation indicates that plant competition will delay natural or artificial tree regeneration, both establishment and growth rate, but that it will not prevent the eventual development of fully-stocked normal stands. A severe limitation indicates that plant competition will prevent adequate natural or artificial tree regeneration without intensive site preparation and maintenance such as weeding.

Seedling mortality refers to the loss of seedlings because of unfavorable soil conditions. Mortality is slight if no more than 25 percent of the seedlings die. It is moderate if 25 to 50 percent of the seedlings die. Mortality is severe if more than 50 percent of the seedlings die.

Windthrow hazard is the danger of trees being blown over by wind. A slight limitation indicates that trees are not expected to be blown down in commonly occurring winds. A moderate limitation indicates that some trees are expected to be blown down during periods of soil wetness and where the wind velocity is moderate or high. A severe limitation indicates that many trees are expected to be blown down during periods of soil wetness and where the wind velocity is moderate or high.

Erosion hazard is the degree of potential soil erosion. A slight limitation indicates that erosion control is not a significant problem. A moderate limitation indicates that sonic, attention must be given to prevent erosion. A severe limitation indicates that intensive treatments, specialized equipment, and methods of operation must be planned to minimize soil erosion.

Special woodland products are mentioned where they are, significant. These products include Christmas trees, cascara, swordfern, and greenery.

Woodland groups

Soils in the survey area have been placed in Woodland groups, mainly according to their potential productivity for Douglas-fir. A woodland group consists of soils that have about the same capability for producing a similar kind of wood crop and that need about the same kind of management.

Woodland groups are identified by a three-part sumbol, for example, 2cl. The first part is a numeral that corresponds to the site class or relative productivity of the soil: *1, very high; 2, high; 3, moderately high; 4, moderate;* and *5, low*.

The second part is a letter that indicates features that produce moderate or severe hazards or limitations in managing the soils for the production of wood crops. The letter c means that clay in the upper part of the soil is a limitation; d, that root depth is restricted; f, that the soil contains large amounts of coarse fragments; o, that the soil has no significant limitations for woodland management; r, that the soil has steep slopes; s, that the soils are sandy; w, that excessive water on or in the soil is a restriction; and x, that stones or rocks are a limitation.

The third part of the symbol distinguishes the groups according to degrees of diffiiculty in applying woodland management. A numeral *3*, for example, means that woodland management is more difficult to apply than if the number were *1* or *2*.

In the following paragraphs, the woodland groups are discussed. Not all soils in the survey area have been placed in these groups, because some of the soils are too extensively used for other crops of high value. Other soils are not well suited to conifers. The names of soil series represented are mentioned in the description of each woodland group, but this does not mean that all soils in a given series are in the group. To find the names of all soils in any given woodland group, refer to the "Guide to Mapping Units" at the back of this soil survey.

WOODLAND GROUP 2cl

This group consists of well-drained soils of the Peavine and Willakenzie series. These soils have a surface layer of silty clay loam and a subsoil of silty clay loam and silty clay. They are on uplands. Slopes are 2 to 30 percent. Elevations range from 250 to 1,200 feet. Annual precipitation is 40 to 70 inches. Average annual air temperature is 52° F., and the growing season is 164 to 210 days.

Fertility of these soils is moderate. Roots penetrate to a depth of 20 inches to more than 40 inches. Available water capacity is 3 to 7.5 inches. Permeability is moderately slow, runoff is slow to medium, and the erosion hazard is moderate to severe.

These soils produce good stands of Douglas-fir. Oregon white oak mixed with fir grows in places at the lower elevations on south-facing slopes, especially on the Willakenzie soils. Bigleaf maple and dogwood are common trees. Other plants are brackenfern, madrona, hazel, poison-oak, snowberry, and swordfern.

Most of the soils of this group are in site class II for Douglas-fir. The estimated site index for this species is about 155 to 160. That for the moderately shallow Willakenzie soils is about 10 feet less.

Equipment limitations are moderate. When wet, these soils are plastic and unstable.

Plant competition is moderate. Nonstocked, cutover areas can present special problems in reducing brush and fern competition.

Seedling mortality is slight. These soils are good suppliers of moisture. Natural regeneration is usually adequate, but supplemental site preparation and planting is needed in places. Windthrow hazard is slight.

Construction of water bars and the seeding of cuts and fills help protect roads and landings from erosion.

Some of the soils of this group have been extensively cleared for pasture and cultivation.

WOODLAND GROUP 2c2

This group consists of well-drained soils of the Astoria, Ead, and Melby series. These soils have a surface layer of silty clay loam and a subsoil of silty clay or light day. They are on uplands. Slopes are 3 to 30 percent. Elevations range from 400 to 2,500 feet. Annual precipitation is 60 to 90 inches. Average annual air temperature is about 49° F., and the growing- season is 145 to 200 days. Fertility of these soils is moderate or moderately low.

Roots penetrate to a depth of 20 inches to more than 40 inches. Available water capacity is 3 to 11 inches. Permeability is moderate or moderately slow. Runoff is medium, and the erosion hazard is moderate.

These soils produce good stands of Douglas-fir. Hemlock grows in many places as an understory or is mixed with fir in the overstory, particularly at high elevations. Alder readily seeds in on cutover and disturbed areas and can grow to merchantable size. Understory plants are vine maple, swordfern, oxalis, salal, and red huckleberry. Brackenfern increases rapidly where stands are removed. Swordfern is abundant and is a good source of greenery.

The soils of this group are in site class II for Douglas-fir. Measured site index for this species averages 165 within a range of 155 to 175.

Equipment limitations are moderate. Trafficability is good during dry weather, but the soils are plastic and unstable when wet, and heavy equipment cuts deeply into the soils causing compaction.

Plant competition is severe and develops rapidly after stands are removed and the soil surface is disturbed. For this reason natural regeneration should be supported by seeding and planting to insure quick establishment of conifers.

Seedling mortality is slight. The soils remain moist well into the dry summer season, and the moist, marine climate is favorable. Windthrow hazard is slight.

Road cuts and fills are unstable and subject to slumping. Roads need heavy base rock for season-long use. They need adequate water bars to protect them from erosion. Water should be diverted from landings, and areas subject to erosion should be seeded to grass.

WOODLAND GROUP 2c3

This group consists of well-drained soils of the Astoria, Ead, and Melby series. These soils have a surface layer of silt loam or silty clay loam and a subsoil of silty clay or light clay. They are an uplands. Slopes are 30 to 60 percent. Elevations range from 400 to 2,500 feet. Annual precipitation is 60 to 90 inches. Average annual air temperature is about 59° F., and the growing season is 145 to 200 days.

Fertility of these soils is moderate or moderately low. Roots penetrate to a depth of 20 inches to more than 40 inches. Available water capacity is 3 to 11 inches. Permeability is moderate or moderately slow. Runoff is rapid and the erosion hazard is severe.

These soils produce good stands of Douglas-fir. Hemlock grows in many places in the understory or is mixed with fir in the overstory, particularly at high elevations. Alder readily seeds in on cutover and disturbed areas and grows to merchantable size in places. Understory plants are vine maple, swordfern, oxalis, salal, and red huckleberry. Brackenfern increases readily where stands are removed. Swordfern is abundant and is a good source of greenery.

The soils of this group are in site class II for Douglas-fir. Measured site index averages 165 within a range of 155 to 175.

Equipment limitations are moderate to severe because of slope gradients. The soils are plastic and unstable when wet. Under those conditions, heavy equipment cuts deeply into the soils causing compaction.

Plant competition is severe and develops rapidly after stands are removed and the soil surface is disturbed.

Seedling mortality is slight. The soils are moist well into the dry summer season and the moist, marine climate is favorable. Windthrow hazard is slight.

Road cuts and fills are unstable and subject to slumping. Roads need heavy base rock for season-long use. They need adequate water bars to protect them from erosion. Water should be diverted from landings, and areas subject to erosion should be seeded to grass.

WOODLAND GROUP 2rl

This group consists of well-drained soils of the Laurelwood, Peavine, and Willakenzie series. These soils have a surface layer of silt loam and silty clay loam and a subsoil of silty clay loam and silty clay. They are on uplands. Slopes are 30 to 60 percent. Elevations range from 250 to 1,200 feet. Annual precipitation is 40 to 70 inches. Average annual air temperature is 52° F., and the growing season is 165 to 210 days.

Fertility of these soils is moderate. Roots penetrate to a depth of 30 inches to more than 40 inches. Available water capacity is 5 to 12 inches. Permeability is moderate or moderately slow. Runoff is rapid and the erosion hazard is severe.

These soils produce good stands of Douglas-fir. Oregon white oak and fir grow in places at the lower elevations on south-facing slopes, especially on the Willakenzie soil. Bigleaf maple, dogwood, alder, and grand fir grow in

many places. Other plants include brackenfern, madrona, hazel, poison-oak, snowberry, and swordfern.

The soils of this group are in site class II for Douglas-fir. Estimated site index for this species is 155 to 160.

Equipment limitations are moderate to severe. Trafficability is limited by steep slopes, and the soils are unstable during the wet season.

Plant competition is moderate. Nonstocked cutover areas can present special problems in reducing brush and fern competition.

Seedling mortality is slight. The soils are good suppliers of moisture. Natural tree regeneration is sometimes adequate, but because site preparation is difficult on the, steep slopes, it is important to restock recent cutovers immediately following harvest. Weeding and thinning are usually needed for development of the best stand. Windthrow hazard is slight.

Roads and landings must be carefully located and protected from erosion.

WOODLAND GROUP 2r2

This group consists of well-drained soils of the Hembre and Olyic series. These soils have a surface layer of silt loam and a subsoil of silty clay loam. They are on uplands. Slopes are 30 to 60 percent. Elevations range from 500 to 2,800 feet. Annual precipitation is 60 to 110 inches. Average annual air temperature is about 49° F., and the growing season is 145 to 200 days.

Fertility of these soils is moderate. Roots penetrate to a depth of 40 inches or more. Available water capacity is 7 to 12 inches. Permeability is moderate or moderately slow. Runoff is rapid, and the erosion hazard is severe.

These soils produce good stands of Douglas-fir and bigleaf maple. Western hemlock and fir grow at elevations above 2,000 feet. Alder readily seeds in on disturbed areas. Understory plants are vine maple, red huckleberry, swordfern, oxalis, and salal. Swordfern is an important commercial crop.

The soils of this group are in site class II for Douglas-fir. Site index for this species for the Hembre soil is 165 and site index for the Olyic soil is 160. Measurements indicate that at elevations above 2,000 feet, the site index of the Hembre soil may be 20 feet less.

Equipment limitations are moderate to severe. Trafficability is limited by steep slopes and the wet season. Operation of tractors causes excessive soil disturbance.

Plant competition is moderate and develops rapidly after stands are removed.

Seedling mortality is slight. The soils have good moisture supplying capacity and are in a favorable climatic zone. Natural regeneration generally is good, but in places it needs to be supplemented with site preparation, seeding, and planting. Weeding and thinning are needed for good stand development. Windthrow hazard is slight.

Roads and landings and other critical areas need special management to prevent erosion. Water bars, diversions, and grass seeding are needed. The soils are stable, and roads require a minimum of base rock for season-long use.

WOODLAND GROUP 2r3

This group consists of well-drained soils of the Hembre and Olyic series. These soils have a surface layer of silt loam and a subsoil of silty clay loam. They are on uplands. Slopes are 60 to 90 percent. Elevations range from 500 to 2,800 feet. Annual precipitation is 60 to 110 inches. Average annual air temperature is about 49° F., and the growing season is 145 to 200 days.

Fertility of these soils is moderate. Roots penetrate to a depth of 40 inches or more. Available water capacity is 7 to 12 inches. Permeability is moderate or moderately slow. Runoff is rapid and the erosion hazard is severe.

These soils produce good stands of Douglas-fir and bigleaf maple. Western hemlock is mixed with fir at elevations above 2,000 feet. Alder readily seeds in on disturbed areas. Understory plants are vine maple, red huckleberry, swordfern, oxalis, and salal.

Soils of this group are in site class II for Douglas-fir. Site index for this species is 165 on the Hembre soil and 160 on the Olyic soil. Measurements indicate that at elevations above 2,000 feet, the site index of the Hembre soil may be 20 feet less.

Equipment limitations are severe. The very steep slopes limit most operations to cable logging and aerial seeding and weeding.

Plant competition is moderate and develops rapidly after stands are removed.

Seedling mortality is slight. The soils have good moisture supplying capacity and are in a favorable climatic zone. Natural regeneration needs to be supplemented by aerial seeding in places. Weeding is practically limited to aerial application of chemicals. Windthrow hazard is slight.

Construction and maintenance of roads are difficult because of very steep slopes and ledge rock.

WOODLAND GROUP 2ol

This group consists of well-drained soils of tile Laurelwood series. These soils have a surface layer of silt loam and a subsoil of silty clay loam. They are on uplands. Slopes are, 3 to 30 percent. Elevations range from 300 to 1,200 feet. Annual precipitation is 45 to 50 inches. Anmial air temperature is about 51° F., and the growing season is 165 to 210 days.

Fertility of these soils is moderate. Roots penetrate to a depth of more than 40 inches. Available water capacity is 7.5 to 12 inches. Permeability is moderate. Runoff is slow to medium, and the erosion hazard is moderate to severe.

These soils produce good stands of Douglas-fir and bigleaf maple. Other plants are Oregon-grape, brackenfern, snowberry, and swordfern.

These soils are in site class II for Douglas-fir. Estimated site index for this species is about 155 to 160.

Equipment limitations are moderate.

Plant competition is moderate. Nonstocked, cutover areas can present special problems in reducing competition from brush and ferns.

Seedling mortality is slight. The soils have good moisture supplying capacity. Natural regeneration is usually adequate, but supplemental site preparation and planting is needed in places. Windthrow hazard is slight.

Construction of water bars and seeding of cuts and fills are needed in places to protect roads and landings from erosion.

Some of tile soils of this group have been extensively cleared for pasture and cultivation.

WOODLAND GROUP 2o2

This group consists of well-drained soils of the Hembre, Knappa, and Olyic series. These soils have a surface layer of silt loam and a subsoil of silty clay loam. They are on terraces and up1ands. Slopes are 0 to 30 percent. Elevations range from 50 to 2,800 feet. Annual precipitation is 60 to 110 inches. Average annual air temperature is about 49° F., and the growing season is 145 to 210 days.

Fertility of these soils is moderate. Roots penetrate to depths of 40 inches to more than 60 inches. Available water capacity is 7 to 12 inches. Permeability is moderate or moderately slow. Runoff is slow to medium, and the erosion hazard is slight to moderate.

These soils produce good stands of Douglas-fir and bigleaf maple. Alder readily seeds in undisturbed areas. Western hemlock generally is in the understory and is mixed with fir at higher elevations. Understory plants are vine maple, swordfern, oxalis, salal, and red huckleberry. Swordfern is abundant and is a good source of greenery.

Soils of this group are in site class II for Douglas-fir. Site index for this species for the Hembre soil is 165, and site index for the Knappa and Olyic soils is 160. Measurements indicate that at elevations above 2,000 feet the site index of the Hembre soil may be 20 feet less.

Equipment limitations are slight. Trafficability is good except during very wet periods. There are few limitations to an any kind of vehicle operation.

Plant competition is generally moderate. It is severe at the lower elevations and in moist areas where alder, salmonberry, and vine maple grow well and often prevent establishment of conifers.

Seedling mortality is slight. The soils have good mois ture supplying capacity and are in a favorable climatic zone. Natural regeneration generally is good but needs to be supplemented with site preparation, seeding, and planting in places. Weeding and thinning are needed for good stand development. Windthrow hazard is slight.

Constructing of water bars and seeding grass are necessary to prevent erosion of roads and landings.

WOODLAND GROUP 3c1

This group consists of well-drained soils of the Jory, Nekia, and Yamhill series. These soils have a surface layer of silt loam and clay loam and a subsoil of clay or silty clay. They are on uplands. Slopes are 2 to 30 percent. Elevations range from 250 to 1,200 feet. Annual precipitation is 40 to 60 inches. Average annual air temperature is 48° to 56° F., and the growing season is 165 to 210 days.

Fertility of these soils is moderate. Roots penetrate to a depth of 20 inches to more than 40 inches. Available water capacity is 3 to 11 inches. Permeability is moderately slow. runoff is slow to medium, and the erosion hazard is slight to severe.

These soils produce good stands of Douglas-fir. Oregon white oak and mixed oak and fir are common at the lower elevations on south-facing slopes. Common understory plants are poison-oak and snowberry. Other trees and shrubs include bigeaf maple, dogwood, vine maple, hazel, brackenfern, Oregon-grape, salal, and swordfern.

The soils of this group are in site class III for Douglas-fir. Measured site index for this species on Nekia soils is 136. Estimated site index is 130 for Yamhill soils and 150 for Jory soils.

Equipment limitations are slight and cutbanks are stable. Trafficability is not a major problem, except during the wet winter season.

Plant competition is moderate. Oak may present special problems to the production of Douglas-fir.

Seedling mortality is moderate. Natural regeneration is usually adequate, but in places it must be supplemented with site preparation and planting. Old, nonstocked cutover areas need special treatment. Weeding and thinning generally are needed for best stand development. Windthrow hazard is slight except in areas of shallow soils, where, it is severe.

Roads and landings need water diversions and grass seeding to help control soil erosion.

A wide variety of Christmas trees are suited to these soils. Most of the acreage of these soils is used for pasture and crops. Woodland is a good alternative use, especially for the steeper soils.

WOODLAND GROUP 3c2

This group consists of well-drained soils of the Jory and Yamhill series. These soils have a surface layer of silt loam and clay loam and a subsoil of clay or silty clay. They are on uplands. Slopes are 30 to 60 percent. Elevations range from 250 to 1,200 feet. Annual precipitation is 40 to 60 inches. Average annual air temperature is 52° F., and the growing season is 165 to 210 days.

Fertility of these soils is moderate. Roots penetrate to a depth of 20 inches to more than 40 inches. Available water capacity is to 11 inches. Permeability is moderate slow. Runoff is medium to rapid and the erosion hazard is severe.

These soils produce good stands of Douglas-fir. Oregon white. oak, and mixed oak and fir are common at the lower elevations on south-facing, slopes. Common understory p1ants are poison-oak and snowberry. Other plants include bigleaf maple, dogwood, vine maple, hazel, brackenfern, Oregon-grape, salal, and swordfern.

The soils in this group are in site class III for Douglas-fir. Estimated site index is 130 for Yamhill soils and 150 for Jory soils.

Equipment limitations are moderate where slopes are 60 percent or less and severe where slopes are more than 60 percent. The soils are stable.

Plant competition is moderate. Oak can present special problems to the production of Douglas-fir. Nonstocked cutover areas present special problems in reducing plant competition. Weeding and thinning generally are needed for best stand development.

Seedling mortality is moderate. Natural regeneration generally is adequate, but in places it must be supplemented with site preparation and planting. Windthrow hazard is slight, except in areas of moderately shallow soils, where it is severe.

Roads and landings must. be carefully located, and in places water bars are needed to help prevent erosion. Grass must be seeded on critical areas.

Part of the less steeply sloping areas is used for pasture, but woodland is a good alternative use.

WOODLAND GROUP 3f1

This group consists of one soil, Klickitat stony loam, 5 to 30 percent slopes. This soil is well drained. It has a surface layer of stony loam and a subsoil of stony clay loam. Elevations range from 500 to 3,000 feet. Annual precipitation is 80 to 120 inches. Average annual air temperature is 49° F., and the growing season is 145 to 200 days.

Fertility of this soil is low. Roots penetrate to a depth of more than 30 inches. Available water capacity is 2 to 4 inches. Permeability is moderate. Runoff is medium, and the erosion hazard is moderate.

This soil produces good stands of Douglas-fir. Alder is common, particularly in moist areas along the lower slopes. Alder and maple seldom grow to commercial size. Hemlock is mixed with fir at high elevations, and noble fir is on the highest peaks. Understory plants are vine maple, salal, red huckleberry, thimbleberry, and at high elevations, blue huckleberry.

This soil is in site class III for Douglas-fir. Site index for this species is 142.

Equipment limitations are moderate. This soil is stable and trafficability is good, but stones interfere with operations such as site preparation, planting, and road building.

Plant competition is moderate and develops moderately slowly after stands are removed.

Seeding mortality is moderate. Some losses can be expected from drought, particularly on south slopes. Natural regeneration sometimes is spotty. Where this occurs site preparation, seeding, and planting are needed. Weeding and thinning are needed in places for good stand development. Windthrow hazard is slight.

Roads and landings should be protected with water bars and by grass seeding.

WOODLAND GROUP 3f2

This group consists of one soil, Klickitat stony loam, 30 to 60 percent slopes. This soil is well drained. It has a surface layer of stony loam and a subsoil of stony, clay loam. Elevations range from 500 to 3,000 feet. Annual precipitation is 80 to 120 inches. Average annual air temperature is about 49° F., and the growing season is 145 to 200 days.

Fertility of this soil is low. Roots penetrate to a depth of more than 30 inches. Available water capacity is 2 to 4 inches. Permeability is moderate, runoff is rapid, and the erosion hazard is severe.

This soil produces good stands of Douglas-fir. Alder grows particularly well on north and east slopes. Hemlock is mixed with fir at high elevations, and noble fir is on the highest peaks. Understory plants are vine maple, salal, red huckleberry, thimbleberry, and at high elevations, blue huckleberry.

This soil is in site class III for Douglas-fir. Site index for this species is 142.

Equipment limitations are moderate to severe. Stones and steep slopes interfere with site preparation, planting, road building, harvesting, and other operations.

Plant competition is moderate and develops moderately slowly after stands are removed.

Seedling mortality is moderate. Some losses can be expected from drought, particularly on south slopes. Natural regeneration is spotty in places. Where this occurs, site preparation, seeding, and planting are needed. Windthrow hazard is slight.

Roads and landings should be protected from erosion by water bars and grass seeding.

WOODLAND GROUP 4fl

This group consists of well-drained or excessively drained soils of the Kilchis and Klickitat series. These soils have surface layer of rocky or stony loam and a subsoil of stony clay loam or very stony loam. They are on uplands. Slopes are 60 to 90 percent. Elevations range from 500 to 3,000 feet. Annual precipitation is 80 to 120 inches. Average annual air- temperature is 49° F., and the growing season is 145 to 200 days.

Ferility of these soils is low or very low. Roots penetrate to depths of 12 inches to more than 30 inches. Available water capacity is 2 to 6 inches. Permeability is moderate or moderately rapid. Runoff is rapid, and the erosion hazard is severe.

On these soils, Douglas-fir grows in clumps or is widely spaced. Openings and areas of brush occur where the soils are shallow and rock crops out. Hemlock is mixed with fir at high elevations, and noble fir is on the highest peaks. Understory plants are vine maple, salal, red huckleberry, thimbleberry, and at high elevations, blue huckleberry.

Soils of this group are in site class IV for Douglas-fir. Most areas of these soils are in the "'Tillamook Burn" where there are few trees suited for site measurements. The site index for Douglas-fir is as much as 140 in small areas of deep Kliickitat soils.

Equipment limitations are severe. The very steep slopes limit most operations to cable logging and aerial seeding and weeding.

Plant competition is moderate and develops moderately slowly after stands are removed.

Seedling mortality is severe. The soils are shallow and droughty, particularly on south slopes. Natural regeneration is often spotty or lacking. Natural or aerial seeding are the only available methods of regenerating stands. Windthrow hazard is mioderate because of limited soil depth.

Contruction and maintenance of roads is difficult due to very steep slopes and ledge rock.

Use of the Soils for Wildlife [4]

This section tells about the potential of the soils of the Yamhill Area for wildlife habitat. The principal species of game in the Area are ring-necked pheasant, ruffed grouse, blue grouse, valley quail, bobwhite quail, mountain quail, band-tailed pigeon, mourning dove, ducks, goose, and blacktail deer. There are also many kinds of songbirds and insectivorous birds, small animals, and other nongame species throughout the Area. These have great value for the pleasure they give to persons who live and travel in the Area. Some birds damage fruit crops. Squirrels do considerable damage to grain fields that are intermingled with brushy areas. Gophers are common in many of the well-drained soils.

4James Heintz, Oregon State game agent, Oregon State Game Commission, helped prepare this section.

The occurrence and abundance of some species of wildlife are related to the kinds of soils. Many of the relationships are indirect and are influenced primarily by land use, the kinds of plants, and topography. Wildlife generally is more abundant, the individual animals tend to be larger, and the rate of production is higher on the fertile soils than on the less fertile soils.

The suitability for a species of game is strongly influenced by the present stage of plant succession, and the stage of succession in which man tends to keep the land. A burned-over woodland area, for instance, goes through many successive changes before it has a full stand of trees again. During each of these changes, it is fair or good habitat for some species and poor for others. Some species thrive through several changes. Use of an area is dependent upon how much adjacent area is opened by fire or logging in relation to the areas that are not opened up.

Most land in the Area is privately owned, so access is controlled by the landowners. Most farms, tree farms, and areas of publicly owned land are open to hunters in season. Hunting on private land is done by permission of the landowner. Some farms are closed to hunting. Low humidity and extreme fire danger at times affect the opening dates and duration of hunting seasons during summer and early in fall. Some of the land is in parks, wildlife refuges, and private and public shooting preserves. The landowner can obtain information from the Soil Conservation Service and the Oregon State Game Commission about trees, shrubs, vines, and crops that favor wildlife. Local soil conservationists and wildlife technicians also can help determine the most beneficial practices to use to establish wildlife on a particular farm.

Burning fields and fence rows destroys food and cover for wildlife.

Wildlife groups

Each soil in the Yamhill Area has been rated according to its suitability for food and cover for the various game birds and animals in table 4. The group in which each mapping unit has been placed is shown in the "Guide to Mapping Units" at the end of this soil survey. The ratings given for each group in table 4 (good, fair, and poor) take into account the characteristics and productivity of the soils, the topography and land use, and the kind of food and cover preferred by the species concerned.

Soil groupings, in addition to that information given in other sections of this survey and soil maps, help in planning for wildlife developments. Detailed onsite investigations are needed for many developments.

WILDLIFE GROUP 1

The group consists of somewhat excessively drained to somewhat poorly drained soils of the Aloha, Briedwell, Carlton, Chehalem, Chehalis, Cloquato, Knappa, McBee, Newberg, Williamette, and Woodburn series. Those, soils are on bottom lands, fans, terraces, and foot slopes. They have a surface layer of fine sandy loam to silty clay loam and a subsoil of sandy loam to silty clay. The Briedwell soils are moderately deep to gravel and cobblestones. The

In the original manuscript, there was a table in this space.
All tables have been updated and are available as a separate document.

other soils are deep or very deep. Slopes range from 0 to 20 percent. Elevations range from 30 to 400 feet. Annual precipitation is 60 to 70 inches on the Knappa soil and 40 to 60 inches on the other soils. Average annual temperature is 19° to 53° F., and the frost-free season is 145 to 210 days.

The fertility of these soils is moderate to high. Roots penetrate to a depth of about 40 inches in the Briedwell soils and to more than 60 inches in the other soils. Available water capacity is 4 to 13 inches, and permeability is rapid to slow. Runoff is slow to medium, and the erosion hazard generally is slight, but is severe in places.

Good cover for ring-necked pheasant, valley quail, bobwhite quail, and mourning doves grows in areas used for grain, grasses, legumes, and vegetable crops. Orchards, fence rows, shrubs, and woodlots that have ash, cottonwood, Douglas-fir, and grass also provide cover. Blacktail deer are permanent residents on these soils. Ducks and geese feed in areas close to water. Grouse, band-tailed pigeons, and mountain quail are not common on these soils. Gophers, squirrels, nutria, and opossum are the major pests.

Planting along streambanks and roadways, grassing waterways, and maintaining fence rows, woodlots, and areas of brush are practices that improve cover and food for wildlife. Draining the soils increases plant growth.

The soils on terraces have numerous drainageways that are, in many places, suitable for small ponds, many of which can be managed for game fish. Water from larger streams is available most of the year, but most of the small streams and ditches are dry late in summer.

WILDLIFE GROUP 2

This group consists of somewhat poorly drained or poorly drained soils of the Amity, Cove, Dayton, Grande Ronde, Labish, and Wapato series. These soils have a surface layer of silt loam to clay and a subsoil of silty clay loam to clay. They are on bottom lands, fans, lake beds, and terraces. Slopes are 0 to 7 percent. Elevations range from 30 to 500 feet. Annual precipitation is 40 to 80 inches. Average annual temperature is 49° to 54° F., and the frost-free season is 165 to 210 days.

Fertility of these soils is mainly low to moderate, but is high in places. Roots penetrate to a depth of 60 inches or more in the Amity soil, but they are restricted by a clay subsoil or a high temporary water table in the other soils. Available water capacity ranges from 3 to 16 inches. The lower figures are based on the material above clay. Permeability ranges from moderately slow to very slow. Runoff ranges from slow to ponded, and the erosion hazard is slight.

Most of the soils are cleared and are used for grain, seed crops, hay, and pasture. Native vegetation is ash, willow, sedges, and grass. High water tables, overflow, and ponding limit the use of these soils to ducks and geese late in fall, in winter, and early in spring. Waterfowl feed on seeds and tubers from water plants and crop residues on the well-drained soils adjacent to this area. During the rest of the year, ring-necked pheasants, valley quail, bobwhite quail, mourning doves, and blacktail deer move into this area for food and cover. These soils are used for habitat by fur-bearing animals, which become pests. Grouse, band-tailed pigeons, and mountain quail are not common on these soils.

Water control structures, such as dikes, small dams, drainage ditches, and tile systems, improve the habitat for ducks and geese during winter and for other game species during the rest of the year. Cover and food supplies are also improved by planting on streambanks, ditchbanks, and roadways, grassing waterways, and maintaining fence rows, woodlots, and brush areas. Springs, streams, and wet areas furnish water throughout the year.

WILDLIFE GROUP 3

This group consists of well-drained to poorly drained soils of the Dupee, Hazelair, Jory, Laurelwood, Nekia, Panther, Peavine, Steiwer, Willakenzie, and Yamhill series. These soils have a surface layer of silt loam to silty clay loam or clay loam and a subsoil of silty clay loam or clay loam to clay. They are moderately deep to very deep. The underlying bedrock is sedimentary rock or basalt. These soils are on the uplands. Slopes are 2 to 30 percent. Elevations range from 170 to 1,200 feet. Annual precipitation is 40 to 70 inches. Average annual temperature is 48° to 54° F., and the frost-free season is 165 to 210 days.

Fertility of these soils is low or moderate. Roots penetrate to bedrock or clay, which is at depths of 10 inches to 60 inches or more. Available water capacity ranges from 3 to 12 inches. Permeability ranges from moderate to very slow. Runoff is slow or medium, and the erosion hazard ranges from slight to severe.

These soils are used for Orchards, grain, and grass and legume seed, which provide food and cover for ringnecked pheasants, valley quail, and bobwhite quail. Ruffed grouse, mountain quail, and band-tailed pigeons inhabit wooded areas where oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grass grow. These birds feed on the fruit and seeds of the Pacific dogwood, madrone, elderberry, cascara, and other plants. Band-tailed pigeons are most numerous around the mineral springs late in summer and early in fall. Blacktail deer use both cultivated and noncultivated areas for food and cover. Gophers, squirrels, and other burrowing animals are the major pests on these soils.

Planting Douglas-fir, grassing waterways, plantings along roads, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife. Numerous draws and drainageways are suitable for small ponds. Except for a few major creeks and springs, the drainageways are dry late in summer.

WILDLIFE GROUP 4

This group consists of well-drained soils of the Jory, Laurelwood, Melby, Olyic, Peavine, Steiwer, Terrace escarpments, Willakenzie, and Yamhill series. They have a surface layer of silt loam to silty clay loam or clay loam and a subsoil of silty clay loam or clay loam to clay. They are moderately deep to very deep. The underlying bedrock is sedimentary or basalt. These soils are on the uplands. Slopes are 2 to 90 percent. Elevations range from 250 to 2,000 feet. Annual precipitation is 40 to 80 inches. Average annual temperature is 49° to 56° F., and the frost-free season is 145 to 210 days.

Fertility of these soils generally is moderate but is low on Steiwer soils. Roots penetrate to bedrock, which is at a depth of 20 inches to more than 40 inches. Available water capacity ranges from 3.5 to 12 inches. Permeability is moderately slow or moderate. Runoff ranges from slow to rapid, and the erosion hazard ranges front slight to severe, although generally it is severe.

These soils are too steep for cultivation and are commonly a mile or more from cultivated areas. Where intermingled with cultivated land, these soils provide habitat for ring-necked pheasants, valley quail, and bobwhite quail. Douglas-fir, oak, hazel, bigleaf maple, alder, and other trees and shrubs are important food and cover plants. Ruffed grouse, mountain quail, and band-tailed pigeons use the leaves, buds, nuts, fruit, and seed from the Pacific dogwood, madrone, elderberry, cascara, and other plants for food. Blacktail deer use these soils extensively for food and cover.

Numerous draws and drainageways are suitable for small ponds. Except for a few major creeks and springs, the drainageways are dry late in summer.

WILDLIFE GROUP 5

This group consists of well-drained to excessively drained soils of the Astoria, Ead, Hembre, Kilchis, and Klickitat series. These soils have a surface layer of silt loam, silty clay loam, or stony loam, and a subsoil of clay to very stony loam. They are shallow to deep over sedimentary or basalt bedrock. These soils are on the uplands of the Coast Range. Slopes are 3 to 90 percent. Included in this group are small areas of Fresh water marsh and Alluvial land. Elevations range from 400 to 3,000 feet. Annual precipitation is 60 to 120 inches. Average annual temperature is 49° F., and the frost-free season is 145 to 200 days.

Fertility of these soils ranges from moderate to very low. Roots penetrate to bedrock, which is at depths of 12 inches to 50 inches or more. Available water capacity ranges from less than 3 inches to 10 inches. Permeability is moderate or moderately rapid. Runoff ranges from slow to rapid, and the erosion hazard is moderate or severe.

These soils are more than a mile from cultivated areas. The vegetation is Douglas-fir, hemlock, cedar, alder, vine maple, swordfern, salal, and other trees and shrubs. Blue grouse, ruffed grouse, and blacktail deer are numerous. Small herds of Roosevelt elk inhabit some areas of these soils. Some of the soils are in the northwest corner of the Yamhill Area in an area called the "Tillamook Burn." The burn is often closed to entry in summer and early in fall because of low atmospheric humidity and the severe fire hazard. This area is very brushy and is slowly becoming revegetated with Douglas-fir.

Except for a few major creeks and springs, the drainageways are dry during July, August, and September. Cool sea breezes and fog often add moisture during this dry period. There are numerous draws and drainageways suitable for small ponds.

WILDLIFE GROUP 6

This group consists of Shale rock land and Stony land over sedimentary rock and basalt. The soils are well drained and less than 20 inches deep to bedrock. They have gentle to very steep slopes. Elevations range from 30 to 3,000 feet. Annual precipitation is 40 to 120 inches, and the frost-free season is 145 to 210 days.

Fertility of these soils is low. Roots penetrate to a depth of as much as 20 inches. Available water capacity ranges from 2 to 5 inches. Permeability ranges from moderate to slow. Runoff is slow to rapid, and the erosion hazard is moderate to severe.

The vegetation is sparse and is mainly willow, oak, poison-oak, grass, Douglas-fir, shrubs, and moss. This group provides important cover for many birds.

The trees and shrubs should be maintained and im-

proved where possible. Plants should be protected from fire and grazing. Water is scarce on these soils, but usually is available on soils nearby.

Engineering Uses of the Soils

Engineers will be interested in the effect of some soil properties on the construction and maintenance of drainage systems, erosion control structures, reservoirs and farm ponds, irrigation systems, building foundations, sewage disposal systems, roads, airports, and pipelines. Soil properties of special interest are permeability to water, shear strength, consolidation characteristics, texture, plasticity, and pH. Topography, stability, and depth of unconsolidated material are also of interest.

The information in this and other sections of the survey call be used by engineers to:

1. Make preliminary estimates of the engineering properties of soils, to help in the planning of agricultural drainage systems, reservoirs and farm ponds, irrigation systems, waterways, and dikes.
2. Make soil and land use studies to aid in selecting and developing industrial, commercial, residential, and recreational sites.
3. Make preliminary evaluations of soil and ground conditions to aid in selecting highway and airport locations and in planning detailed investigations of selected sites.
4. Locate probable Sources of sand, gravel, rock, and other construction materials.
5. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction and logging equipment.
6. Correlate performance of engineering structures with soil mapping units to add to the information needed in designing and maintaining structures.
7. Supplement information obtained from other published maps and reports and aerial photographs for the purpose of making maps and reports that will be useful to engineers.

It should be emphasized that the interpretations made in this soil survey are not a substitute for the sampling and testing needed at a site chosen for a specific engineering work that involves heavy loads or at a site where excavations are to be deeper than the depths of the layers here reported. Also, engineers should not apply specific values to the estimates for bearing capacity given in this survey. Nevertheless, by using this survey, an engineer can select and concentrate on those soil units most important for his proposed kind of construction, and in this manner reduce the number of soil samples taken for laboratory testing and complete an adequate soil investigation at minimum cost.

The soil mapping units shown on the maps in this survey can include small areas of a different soil material. These included soils call be as much as 2 acres in size. They are too small to be mapped separately and generally are not significant to farming in the Area but can be important in engineering planning.

Information of value in planning engineering work is given throughout the text, particularly in the sections "Descriptions of the Soils" and "Formation and Classification of the Soils."

Some of the terms used by the scientist may be unfamiliar to the engineer, and some words-for example, soil, clay, silt, and sand-have special meaning in soil science. These and other special terms are defined in the Glossary at the back of this survey. Most of the information about engineering is given in tables 5, 6, and 7.

[5] NORMAN D. WHEELER, area engineer, Soil Conservation Service, helped prepare this section

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Engineering classification systems

Two systems of classifying soils are in general use among engineers (14). Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (AASHO) (1). The performance of soils -when used for highways is the basis of this system of classification. In this system soils are classified according to gradation, liquid limit, and plasticity index. All soil materials are classified in seven principal groups and one minor group. The groups range from A-1 gravelly soils of high-bearing capacity that are the best soils for subgrade, to A-7, clay soils having low strength when wet that are the poorest soils for subgrade. Group A-8 designates peat or soils that are very high in organic-matter content. Within each group, the relative engineering value of the soil material is indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest. The group index number is in parenthesis after the soil group symbol in table 5. The AASHO classification for tested soils, including the index number, is shown in table 5; the estimated classification for all soils mapped in the survey area is given in table 6.

Some engineers use the Unified soil classification system (22). This system classifies soils according to their texture, plasticity, and organic-matter content. There are 8 classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; 6 classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and 1 class of highly organic soils, identified as Pt. The classification of the tested soils according to the Unified system is given in table 5, and the estimated classification of all the soils is given in table 6.

Engineering test data

Samples from soils of three series representative of the Yamhill Area were tested by standard AASHO procedures to help evaluate the soils for engineering purposes. Only selected layers of each soil were sampled. The results of these tests and the classification of each soil sample according to both the AASHO and Unified systems are shown in table 5. The samples tested do not represent the entire range of soil characteristics in the Area, or even within the soil series sampled. The results of the tests, however, can be used as a general guide in estimating the physical properties of the soils. Tests made were for moisture-density relationships, grain-size distribution, liquid limit, and plasticity index.

In the moisture density, or compaction test, a sample of the soil material is compacted several times with a constant compactive effort, each time at a successively higher moisture content. The moisture content increases until the optimum moisture content is reached. After that the density decreases with increase in moisture content. The highest density obtained in the compaction test is termed "maximum dry density." Moisture- density data are important in construction, for as a rule, optimum sta-

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bility is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

The results of the mechanical analysis, obtained by combined sieve and hydrometer methods, can be used to determine the relative proportions of the different size particles that make up the soil sample. The percentage of fine-grained material determined by the hydrometer method should not be used in determining textural classes of soils.

Mechanical analyses show the percentage, by weight, of soil particles that pass sieves of specified sizes. Sand and other coarser materials do not pass through the No. 200 sieve. Silt and clay pass through the No. 200 sieve. Silt is that material larger than 0.002 millimeter in diameter that passes through the No. 200 sieve, and clay is that fraction passing through the No. 200 sieve that is smaller than 0.002 millimeter in diameter. The clay fraction was determined by the hydrometer method, rather than the pipette method.

Liquid limit and plasticity index indicate the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a solid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. This is termed the liquid limit. The plastic limit is the moisture content at which the material passes from a semisolid to a plastic state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which the soil material is in a plastic condition. Some silty and sandy soils are nonplastic; that is, they do not become plastic at any moisture content.

Engineering properties of soils

Some properties of the soils in the Yamhill Area are shown in table 6. This table contains data on important characteristics of the surface layer, subsoil, and substrata of the modal profile for each of the soil series. Unless otherwise indicated, estimates generally apply to a depth of about 5 feet, and therefore interpretations normally do not apply to a greater depth.

The data for the table were obtained from laboratory tests conducted on representative samples from the profile or by estimating the characteristics of the soil by comparison with similar soils that had been tested.

The table includes three classification systems to identify the soil. First is the USDA textural classification, under which an adjective, name descriptive of the grain-size gradation characteristics of the particular soil is used. Although this system is precisely defined by numerical criteria, the actual classification is made by the soil scientist in the field while examining the soil in its natural state. USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. Sand, silt, clay, and

some of the other terms used in the USDA textural classification are defined in the Glossary.

The Unified and AASHO soil classification systems are explained under the heading "Engineering classification systems."

Soils are placed in hydrologic groups according to their potential to yield precipitation runoff. Knowledge of runoff is needed to estimate volume and peak rate of runoff from specified areas for various lengths and intensities of storms. This information is used in the design of water-control structures. The runoff potential of the soils in various hydrologic groups ranges from those that shed almost no precipitation (group A) to those that shed nearly all precipitation (group D). Texture and depth of soil are good indicators of the absorptive capacity of a soil, but they might not always determine the group in which a soil is placed. A moderately coarse textured soil can seal at the surface under the impact of rain and can, therefore, shed most of the water that falls on it. A soil of finer texture, however, might absorb rain more readily. Other factors must also be considered in grouping a soil. Soils in the Yamhill Area have been placed in hydrologic groups B, C, or D according to their potential for yielding runoff. None of the soils is in group A. The four hydrologic groups are defined as follows:

Group A soils have a high infiltration rate even when thoroughly wetted. They consist chiefly of deep, excessively drained sands, or gravel, or both. These soils have a high rate of water transmission and a low runoff potential.

Group B soils have a moderate infiltration rate when thoroughly wetted. They consist chiefly of moderately deep to deep, moderately well drained to well-drained soils that have a moderately fine to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C soils have a slow infiltration rate when thoroughly wetted. They consist chiefly of soils that have a layer that impedes the downward movement of water, or of soils that have moderately fine to fine texture and a slow infiltration rate. These soils have a slow rate, of water transmission.

Group D soils have a very slow infiltration rate when thoroughly wetted. They consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table. soils that have a claypan or clay layer at or near the surface, or shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission.

The permeability rates in inches per hour are estimated for undisturbed soils. The estimates were based on soil texture, structure, and porosity. The available water capacity in inches per inch of soil depth is the approximate amount of water the soil is able to hold available for plant growth when wet to field capacity. When the soil is air dry, this amount of water will wet the soil material described to a depth of 1 inch without deeper percolation.

Reaction indicates the intensity of soil acidity or alkalinity and is expressed in pH, which is the logarithm of the reciprocal of the hydrogen-ion concentration. In this notation a pH value of 7 is neutral; lower values indicate acidity; higher values, alkalinity.

The shrink-swell potential is an indication of the volume change to be expected of the soil material as moisture content changes. The indicated potential is based on the characteristics of the soil. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates a hazard to the maintenance of works that are constructed in, on, or with such material.

Corrosivity, as used here, indicates the potential danger to uncoated steel pipe through chemical action that dissolves or weakens the structural material. Steel pipe corrodes in some kinds of soil more rapidly than in others.

The single numerical entries that are listed for many items in the table indicate the estimated average value of the particular characteristic. In other instances, where the expected variation of values for a particular item are reasonably certain, a range is shown.

Engineering interpretations

Table 7 gives ratings of the suitability of the soils of the Yamhill Area as a source of topsoil, sand, gravel, and road fill. It also gives features that affect work on highways and on structures that conserve soil and water. The interpretations are based on the test data in table 5, the information in table 6, and on field experience.

Climate, physiography, and geology greatly affect the engineering uses of the soils. In the survey area temperatures are mild throughout the year. Annual precipitation is 40 inches to more than 100 inches. Below elevations of 2,000 feet rainfall is intermittent and of low intensity. Above 2,000 feet some of the precipitation is snow. Under these environmental conditions, most soils have developed porous, very stable aggregates that allow most of the precipitation to enter and move through the profile. Therefore, moderate intake rates are typical of most of the soils in the Yamhill Area. Another example of climatic influence is the accumulation of large amounts of organic material in the surface horizon of most soils. Consequently, most of the soils are a good source of topsoil. However, the highly organic materials must be removed from the soils for many engineering uses.

In the Yamhill Area, the broad alluvial terraces and the low foothills have been the areas most intensively used and developed. Most of the larger towns are located on the alluvial terraces adjacent to streams and in most instances are adjacent to the low foothills.

It is important to know something about the geology of the Yamhill Area when locating a highway. The low hills and mountainous uplands that formed from sandstone, siltstone, and shale can be serious problems in highway construction. Movement of the unstable masses, often as a result of prolonged rainfall, seriously affects roads in the Area. In addition to unstable sedimentary bedrock, sloping soils that have a clay subsoil are subject to surface movement in the form of slumps and slides.

Most soils on terraces have a perched water table. Many soils on bottom lands are subject to flooding and ponding and have a high water table in winter and in spring.

The surface horizon of most of the soils has stable aggregates that are resistant to stress or dispersion by water. During prolonged wet periods in mountainous areas, stable soil conditions are essential for logging operations on the many side roads and skid trails.

The medium to very strong acidity of many of the soils requires special preparation of concrete structures that are to come in contact with the soil. Tile used in drainage systems must be made of clay, or a specially prepared grade of concrete.

In table 7 the column headed "Dikes and levees" refers to use of the soils for construction of small dikes to protect low areas along streams from frequent flooding. In many instances, a soil is rated as suitable for this use but its position in the landscape is far removed from likely locations of dike construction. The information under the heading "Farm ponds" indicates that a soil may not be suitable for reservoir areas, but can be used for embankment construction. The reason is that the soil is too sloping or occupies topographic positions that make it unsuitable for reservoir areas. However, the soil might furnish a good source of embankment material for use at nearby sites where the soils are different.

The column under grassed waterways refers to concentrated watercourses that are either in natural grass or constructed. A notation of "not applicable" means that establishing waterways is not feasible because of the position of the soil on the landscape. It can also mean that waterways are of limited extent and are in an included area within the particular soil.

Use of the Soils for Town and Country Planning

Uses of the soils in the survey area are intermixed, and they tend to compete with one another in some places. Farmland and woodland are being taken for the development of facilities for transportation, industries, recreation, and residences. When use of the land changes, new problems involving soil and water conservation arise. This section evaluates the soil properties that can influence the suitability of soils for various town and country uses. The information is intended to serve as a guide for land-use planners and others who are concerned about possible limitations of soils for various intended uses.

Table 8 provides information on the degree and kind of soil limitations for stated uses in town and country planning. This information is not intended to eliminate the need for onsite study and testing of the soils. Landforming and extensive cuts and fills generally alter the soils to the extent that the ratings are no longer applicable.

In making the ratings shown in table 8, all soil features that affect the stated land use were evaluated. Slight limitations mean that the restrictions are easy to overcome. Moderate limitations mean that restrictions normally can be overcome with correct planning, careful design, and good management. Severe limitations mean that the suitability of the soil for the intended purpose is doubtful. Careful planning and above-average design and management are required to overcome severe limitations.

Many soil characteristics were considered in determining the ratings. Depth of soil to clay layers or bedrock is an important consideration for removal of septic tank effluent, or designing foundations for commercial and industrial buildings. Slope of the soil and its potential erosion hazard affects all uses of the land. Steep slopes are often subject to slow soil creep. Surface slides occur on some soils. A seasonal or permanent water table restricts the use of septic tanks, and construction of buildings and roadways. Soil permeability affects most uses and limits some of them. Suitability for bridle paths, footpaths, golf courses, camping and picnic areas will be affected by surface texture and stoniness. Flooding of streams restricts residential and industrial construction. Soil stability and bearing strength must be considered in planning building sites and roadways.

The criteria for determining the limitation rating for each use are given in the following paragraphs.

Sites for residences.-The ratings and limitations are for houses and other buildings that are no more than three stories high. The kind of sewage system is not considered in the evaluation of sites for residences.

Soils that have slight limitations for use as building sites for residences have slopes of less than 12 percent, are well drained or moderately well drained, and are not subject to flooding. Hard rock is at a depth of more than 40 inches. Soils that have moderate limitations for this use are somewhat poorly drained and are not subject to flooding. They have a seasonal high water table, fair stability, or moderate shrink-swell potential in the subsoil. They have slopes of 12 to 20 percent. Soils that have severe limitations for this use are poorly drained or are subject to flooding. They have poor stability, high shrink-swell potential, low shear strength, or high slide hazard. They have slopes of more than 20 percent.

Septic tank filter fields.-The term "septic tank filter fields" refers to a sewage system in which waste is distributed to a central tank and the effluent from the tank is dispersed through lines buried in the soil under a fairly large filter field.

Soils that have slight limitations for use as septic tank filter fields are well drained, are not subject to flooding, are at the upper end of moderate permeability, are more than 50 inches deep to hard rock (23), and have slopes of less than 7 percent. Soils that have moderate limitations for this use generally have slopes of 7 to 12 percent and permeability is at the lower end of moderate. Soils that have severe limitations for this use have slopes of more than 12 percent, have moderately slow to very slow permeability, have a high water table, have hard rock at depths of less than 50 inches, or are subject to flooding.

Sewage lagoons.-A sewage lagoon consists of an impounded area and a dam. The main requirements of a soil for use as a floor for the basis of the lagoon are (1) effective sealing against seepage, (2) an even, fairly level surface, and (3) low organic-matter content.

Soils that have slight limitations for use as sewage lagoons have slopes of less than 2 percent, moderately slow to very slow permeability, and hard rock at depths of more than 60 inches. Soils that have moderate limitations for this use have slopes of 2 to 7 percent, moderate permeability, moderate shrink-swell potential, or a Unified classification of ML or MH. Soils that have severe limitations for this use have slopes in excess of 7 percent, have moderately rapid or rapid permeability, have hard rock at depths of less than 40 inches, have high shrink-swell potential, have excessive organic-matter content, or contain more than 50 percent coarse fragments.

Playgrounds.-Playgrounds refers to use of the soils for football, baseball, badminton, and other similar organized games. These areas are used intensively and should

withstand heavy foot traffic. Suitability of the soil for growing and maintaining vegetation is not considered here, but is an important factor to consider in the final evaluation of a site.

Soils that have slight limitations for use as playgrounds have slopes of less than 3 percent, depth to bedrock of more than 40 inches, good drainage, no slower than moderate permeability, surface texture of silt loam, no surface stones or rock outcrops, and no other coarse fragments on the surface. Soils that have moderate limitations for this use can have one or more of the following features: 3 to 7 percent slopes, depth to bedrock of 20 to 40 inches, somewhat poor drainage, moderately slow or slow permeability, or a surface layer of silty clay loam or clay loam. Soils that have severe limitations for this use can have one or more of the following features: slopes of more than 7 percent, depth to bedrock of less than *20* inches, poor drainage, hazard of flooding, very slow permeability, clay surface layer, high slide hazard, stories that cover more than 3 percent of the surface, or more than *20* percent coarse fragments in the surface layer.

Camp areas.-Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. The soils should be suitable for heavy foot traffic and for limited vehicular traffic. Suitability of the soil for growing and maintaining vegetation is not considered here, but is a factor to consider in the final evaluation of a site.

Soils that have slight limitations for use as camp areas have slopes of less than 7 percent, have moderate, or faster permeability, have a silt loam surface layer, and are not subject to flooding. Soils that have moderate, limitations for this use have, slopes of 7 to *12* percent, have moderately slow or slow permeability, have somewhat poor drainage, have silty clay loam or clay loam surface layer, and are subject to flooding in winter. Soils that have severe limitations for this use have slopes of more than *12* percent, very slow permeability, poor drainage, high slide hazard, 50 percent or more coarse, fragments in the surf ace layer, or a clay surface layer.

Picnic areas.-Limitations of the soils for intensive use as park-type picnic areas are rated in the table. It is assumed that most vehicular traffic is confined to access roads. Suitability of the soil for growing vegetation is not considered here, but is a factor to consider in the final evaluation of a site.

Soils that have slight limitations for use as picnic areas have slopes of less than 7 percent and a surface layer of silt loam or fine sandy loam. Soils that have moderate limitations for this use have slopes of 7 to 12 percent, somewhat poor drainage, or a silty clay loam or clay loam surface layer. Soils that have severe limitations for this use have slopes of more than 12 percent, poor drainage, high slide hazard, 50 percent or more coarse fragments in the surface, or a clay surface layer.

Paths and trails.-Limitations of the soils for use as local and cross-country footpaths and trails and for bridle paths are rated here. It is assumed that these areas are used in the natural state and that little or no soil is moved.

Soils that have slight limitations for use as paths and trails have slopes of less than 12 percent and a surface layer of silt loam or fine sandy loam. Soils that have moderate limitations for this use have slopes of 12 to 30 percent, somewhat poor drainage, or a silty clay loam or a clay loam surface layer. Soils that have severe limitations for this use have slopes in excess of 30 percent, poor drainage, 50 percent or more coarse fragments in the surface layer, or a clay surface layer.

Formation and Classification of the Soils

In this section, the factors that have affected the formation and composition of the soils in Yamhill Area are described, and some important morphological features are discussed. The last part of the section deals with the classification of the soils of the survey area.

Formation of Soils

Soil is formed by weathering and other processes that act on parent material. The characteristics of the soil at any given point depend on the parent material, climate, plants and animals, relief, and time.

The active forces that gradually form a soil from parent material are climate and plant and animal life. Relief strongly influences natural drainage, aeration, runoff, erosion, and exposure to sun and wind. It, therefore, influences the effectiveness of the active soil-forming processes. Generally, soil-forming factors are complex. Each force interacts with others and, slowly but constantly, changes are brought about. A soil passes slowly through stages that can be considered as youth, maturity, and even old age. Therefore, the character and thickness of a soil depend upon the intensity of the soil-forming processes, the length of time during which the various processes have acted, and the resistance of the parent material to change.

At any stage in its history, a soil may be affected by mechanical agencies and use by man. The surface layer may be wholly or partly removed by erosion and the material beneath become exposed. The soil-making forces then begin working on the exposed material to form a new surface layer. Whether or not erosion benefits the growth of plants depends on the rate of erosion and on the supply of plant nutrients available in the new surface layer. Normal geologic erosion can benefit the soil; accelerated erosion caused by improper use of the land can severely limit the use of the land for many years. Grading, shaping, and leveling of land by man rearrange the soil horizons and interrupt the effects of soil-forming factors. Irrigating a soil when it normally is dry has the effect of placing the soil in a different climatic zone. Draining by ditch or tile drains counteracts the effects of relief and climate, thereby changing the relationship among the soil-forming factors. Applying amendments and chemicals affects the chemical composition of the soil and the plant and animal life.

The five soil-forming factors are discussed in the paragraphs that follow.

Parent material

The soils of the Yamhill Area have formed in (1) material weathered directly from bedrock in residuum, (2)

material weathered from rocks in colluvium, (3) material transported by water and laid down in varying proportions as unconsolidated deposits of clay, silt, sand, and gravel, and (4) silty materials transported by wind, usually mantling other soil materials. Soils weathered in residuum colluvium contain minerals and their weathered products that are similar to the original rock. Alluvial material has been mixed so that its original mineralogy is no longer distinct.

Parent material is not completely altered in the process of soil formation. Consequently the soils have many of the original characteristics of the parent material. Soils on flood plains, for example, inherited their sandy texture directly from the parent alluvium. The kind and extent of alteration of parent materials are limited by the original characteristics of the material. For example, soils of the Astoria series that formed on siltstone and shale, which have a low capacity to produce reddish iron oxides, are higher in clay content, are thicker over bedrock, contain softer pebbles and stones, and are less red than soils of the Hembre series that formed on basalt.

In the Yamhill Area, the colluvium derived from sedimentary and basalt rocks that are no older than the Eocene geologic epoch. Both kinds of colluvium are basic in that they generally are low in silica and high in iron, magnesium, and calcium. There is little or no quartz in the basalt, and there is less than 30 percent quartz in the siltstone and shale. Sandstone contains as much as 40 percent quartz in places.

The Tillamook volcanics and younger volcanics and sedimentary rock along the western part of the Yamhill Area formed during the middle Eocene epoch. They include greenish-gray basalt, breccia, much interbedded tuff, and some marine sedimentary interbeds. Major soils formed in areas where these materials are present are Hembre, Klickitat, Olyic, and Yamhill.

The Yamhill and Nestucca formations were deposited along the western part of the area, during the middle and upper Eocene epoch. The Yamhill formation consists of dark-gray siltstone and sandstone. The Nestucca rocks are yellowish-brown, tuffaceous shale, siltstone, and sandstone. Major soils on these formations are Astoria, Ead, Melby, and Peavine.

A variety of tuffaceous siltstones, shales, and sandstones were deposited throughout the central part of the Yamhill Area during most of the Oligocene epoch. They appear to be similar to the Eugene formation south of the Yamhill Area, and to the Pittsburgh Bluff Formation to the north. Willakenzie, Dupee, and Panther soils formed from these rocks.

Columbia River basalt flowed over the Oligocene sediments during the middle Miocene epoch. It is dark-gray to black, hard, finely crystalline basalt, often columnar in structure. Soils of the Nekia and Jory series are on this formation.

A few remnants of semiconsolidated, poorly sorted, deeply weathered gravel, silt, and clay material deposited during the lower Pleistocene epoch are near Sheridan and Newberg. Briedwell soils are on this formation.

During the Pleistocene epoch, a mantle of silt that is most likely of wind-deposited origin was laid over Miocene and Oligocene formations on Chehalem Mountains along the northeast border of the Yamhill Area (17). Only soils of the Laurelwood series formed in this material and in local slopewash (4).

In the upper Pleistocene epoch, faintly stratified, lacustrine silt with interbedded sand and some clay, and scattered erratic pebbles, stones, and boulders of igneous and metamorphic rock were deposited to form the level Willamette Valley floor, where Willamette, Woodburn, Amity, and Dayton soils have formed. Where thin lenses of this material cap older formations, soils of the Carlton, Steiwer, and Hazelair series have formed.

During the Recent epoch, alluvium scoured from older formations has been transported by water to form flood plains and fill channels of present stream channels. It is composed of unconsolidated sand, silt, clay, and gravel. Soils of the Chehalis, Cloquato, Newberg, Wapato, and Cove series have formed here. On fans, the material is poorly sorted and contains varying amounts of rock fragments. Chehalem and Cove, fan phase, soils are typical in these areas.

Climate

Climate affects the formation of soils through its influence on the rate and weathering of rocks, the removal and deposition of materials on and in the soil, the water supply in the soil, and soil temperature. It also affects the soil through its effect on the growth of vegetation.

The Yamhill Area has a modified-marine climate that has few extremes in temperature. The winters are moist and the summers dry. The Area is under the influence, of westerly winds that pick up moisture from, and assume temperatures similar to, the ocean water over which they pass. At the higher elevations in the Coast Range along the western part of the Area, annual precipitation is 80 to 110 inches, and the average annual temperature is 49° F. As the winds flow eastward into the Willamette Valley, precipitation decreases and temperature increases. Annual precipitation on the valley floor is 40 to 60 inches, and the average annual temperature is 53° F. About 70 percent of the precipitation falls in the period November through March. Frequent to continuous leaching of soluble material from the soil, and movement of less soluble and suspended material downward in the soil profile are common throughout the Area during these months.

In the Coast Range, soils are seldom frozen in winter, moisture content seldom reaches the wilting point, and soil-forming processes continue throughout the year. Soils on the Willamette Valley floor are seldom frozen in winter, but they are often dry below a depth of 10 inches for periods of as much as 90 days in summer, which interrupts the processes of soil formation.

In places, the rocks have been weathered to depths of more than 5 feet due to the effects of climate over a long period of time. Rocks more resistant to weathering, or of younger age, have not weathered as deeply.

Climate, mainly precipitation, has strongly influenced the vegetation. In the areas of lower rainfall, Oregon white oak, ash, and cottonwood are the dominant trees, and the understory is grass and shrubs. At higher elevations, where the amount of precipitation is greater, the dominant trees are Douglas-fir and bigleaf maple, and there is a dense stand of intermediate and low-growing trees and shrubs. In the area of greatest precipitation,

Douglas-fir, western hemlock, and western redcedar are dominant in a very dense understory of intermediate and low-growing trees and shrubs. The accumulation of organic matter and humus in the soil increases as precipitation increases and temperature decreases.

More data about the climate is provided in the section "General Nature of the Area."

Plant and animal life

Plants, animals, micro-organisms, earthworms, and other forms of life that live on and in the soil are active in the soil-forming process. The changes they bring about depend mainly on the kind of life processes peculiar to each. The kinds of plants and animals are determined by such features as climate, parent material, relief, drainage, and age of the soil.

Plants affect soil formation chiefly by influencing the kind, amount, and depth distribution of organic material added to the soil; the circulation of nutrients; and the degree of protection furnished the soil surface. Trees, shrubs, and grass add organic matter to the soil in the form of leaves, twigs, roots, and entire plants. Most of this material accumulates on the surface, where it is acted on by micro-organisms, earthworms, and animals, and by chemical reactions brought about by the effects of climate. Decayed material is washed into the surface layer by percolation of water. It darkens the soil by staining soil peds and helps develop a favorable soil structure. The amount of organic matter in the surf ace layer is a balance between additions, mainly by plants, and losses due to oxidation and microbial decomposition. As nutrients are released by the decay of organic material, they are reused by the plants in their natural cycle of living and dying. The need for plants that are efficient foragers for these nutrients is particularly important where soils are subject to a high leaching potential. Where rainfall is high, nutrients that are not used by plant roots can be leached out of the root zone.

Most of the soils of the Yamhill Area formed under a dense growth of trees, shrubs, and grasses, so they have developed a surface layer that averages 10 to 12 inches in thickness and has moderate to strong grades of structure. Soils that formed in young parent material along streams have accumulated the least amount of organic matter. Soils that formed in the cool, moist, densely vegetated areas of the Coast Range have accumulated the, highest amount because of the interaction of soil-forming factors.

Earthworms, insects, moles, and other animals that live in the soil retard soil development by remixing the soil material. Clearing, cultivating, introducing new plants, irrigating, and artificial drainage affect the accumulation and decomposition of organic matter. The apparent results of these activities by man are accelerated erosion and alteration of the surface layer by tillage. Application of lime, fertilizers, and fumigants affects microbial activities and plant-nutrient balance.

Relief

Relief has an important effect on soil development in the Yamhill Area. It is strongly related to the origin of parent material. Generally, soils that formed in alluvium are on nearly level to gently sloping surfaces, and those formed from rock are on the sides of hills.

Slope is an important aspect of relief. The penetration of water decreases and the amount of runoff increases as the slope of a soil increases. Slope strongly affects the susceptibility of a soil to water erosion or to downslope movement.

Through its effect on natural drainage, relief influences the formation of several different soils from similar parent material. Water is concentrated in some of the soils so that they are wet for a significant part of the year. This wetness causes mottled color patterns in the' soil through oxidation and reduction of iron-oxide compounds. The ferric-oxide colors are red or yellow, and the ferrous compounds tend to be blue or gray.

The moderately well drained and somewhat poorly drained soils are intermittently aerated and waterlogged. They tend to have yellowish and reddish mottles intermingled with gray in their lower horizons.

The poorly drained soils are predominantly gray colored and have some intermingled yellowish and brownish mottles.

Where relief has caused water to concentrate, the displacement of clay minerals from the surface layer to the subsoil is more pronounced than in adjacent well-drained soils on similar parent material. Leaching of soluble material is often counterbalanced by the accumulation of soluble material from the leaching of higher lying soils, so that the subsoil can show an increase in these materials. In many soils this is demonstrated by air increase in acidity with depth for well-drained soils, and by a decrease with depth for poorly drained soils.

Four general types of landscape are in the Yamhill Area.

The first consists of areas of recent stream-deposited material that are occupied by nearly level and gently undulating soils and that are dissected in places by shallow, meandering drainageways. The well-drained Newberg, Cloquato, and Chehalis soils are gently undulating. The more poorly drained McBee, Wapato, and Cove soils are in the lower lying, concave areas and are subject to ponding from overflow or seepage. The Labish soils are nearly level.

The second type of landscape consists of areas of old alluvium that forms the floor of the Willamette Valley. These areas are occupied by nearly level to gently sloping soils, and they have been dissected by numerous drainageways and streams that are deeply incised in many places. The soils range from the Willamette soils on the higher nearly level to gently sloping sites, to the poorly drained Dayton soils that are on nearly level relief.

The third type of landscape consists of areas of the low hills and Coast Range foot slopes occupied by rolling soils that have formed from a variety of parent materials. In these areas relief is most pronounced in its influence on soil formation where the soils formed in material weathered from sedimentary rock. Soils such as Steiwer, Willakenzie, and Peavine formed on the convex, well-aerated sites. Dupee soils formed in the more nearly level or slightly concave areas. Poorly drained Panther soils are in concave swales and depressions. Nekia and Jory soils that formed on basalt parent materials appear not to be affected by relief and have developed similarly over convex and concave landscapes.

The fourth type of landscape encompasses the Coast Range. Soils formed over sedimentary rock on the Coast

Range have developed uniformly, but as the gradient of the slope increases, the tendency to slumping and downslope movement increases. Steep soils that formed over basalt tend to be more stony and shallow than those formed in material weathered from sedimentary rock.

Soils in the Yamhill Area that have a cover of natural vegetation are resistant to water erosion. Mass movement of soil material downslope, however, still occurs where the soils are steep and are not stable.

Time

The length of time the parent material has been in place and exposed to the active forces of climate and vegetation is an important factor in soil formation. However, the age of a soil refers to its degree of profile development and is influenced by other factors as well as time. A mature soil is one that has well-defined, genetically related horizons; all immature soil is one that shows little or no horizonation. In relatively warm, humid regions that have dense vegetation, such as the Yamhill Area, less time is needed for a soil to develop a distinct profile, than in dry or cold regions that have sparse vegetation.

Because of differences in relief and parent material, soils that have been developing for about the same length of time will not necessarily have reached the same stage of profile development. If the parent rock is weather resistant, profile development is slow. The slumping of soils on hills changes soil profiles by burying and mixing of material in the slump block. This can expose new surfaces to weathering so that soils such as Jory, Nekia, and shallow stony soils exhibit different degrees of development on a similar parent material. On steep slopes, normal geologic erosion removes soil material almost as soon as it forms, consequently, no well-defined horizons develop in Kilchis soils. A parent material can be affected by relief so that different degrees of weathering result in soils such as Willakenzie on convex slopes and Dupee and Panther soils in concave surf aces.

Cloquato and Newberg soils show little development of a soil profile because they are on flood plains where their parent material is being continually added to by new deposition. Soils on the old alluvial terraces show more profile, development, but some of them are developing in stratified parent materials that differ in age. Alluvial falls overlie the terraces, but the soils on these falls show greater profile development than the terrace soils of older age.

Morphology of Soils

The five soil-forming factors have all affected in some way the development of soils in the Yamhill Area. The effect of these factors is shown in the kind and sequence of layers or horizons in the soil profiles. These horizons are apparent in many road cuts and ditchbanks, but they can best be examined in a soil pit that is dug where the soil is in its natural condition.

In the Yamhill Area, the differentiation of horizons and the development of some of their characteristics is the result of one or more of the following: (1) accumulation of organic matter in the surface layer (A horizon), (2) accumulation of silicate clay in the subsoil (B horizon), (3) base-saturation levels, and (4) free-iron accumulation. Each of these factors is discussed in the paragraphs that follow.

Accumulation of organic matter. Almost all the soils in the Yamhill Area have all A horizon that contains all accumulation of organic matter. The amount of organic matter is a balance between additions, mainly from plants, and losses, mainly through oxidation caused by microbial decomposition.

Soils in the Coast Range have the highest organic-matter levels (see table 10 for laboratory analysis of Astoria and Peavine soils). Plants grow vigorously because rainfall is heavy and moisture is available throughout the year. Decomposition is active all year, but low summer temperature, together with low base saturation, probably reduces the rate of decomposition, so that high content of organic matter is maintained.

Soils on the low hills and foot slopes have moderate amounts of organic matter (see table 10 for data on Willakenzie soils). In these, areas summer temperatures are warmer than in the Coast Range, rainfall lighter, and the soils may be dry for 60 days or more late in summer. Plants are also less vigorous here, and decomposition is more rapid.

Soils on the Willamette Valley floor and flood plains have the lowest organic-matter content (see table 10 for data on the Cloquato soil). Rainfall here is the lightest in the Yamhill Area, summers are warmest, and soils are usually dry for more than 60 days late in summer, so plant growth is neither rapid nor dense. The Labish soil is an exception, because it developed in peaty parent material.

Accumulation of silicate clay. Most of the soils in the Yamhill Area have characteristics commonly associated with a B horizon, more clay and higher color values and chromas than the overlying A horizon and a well-defined structure. The increase in clay has resulted from the translocation of silicate clay minerals, and formation of more clay from primary minerals in the B horizon than in other horizons.

The B horizons in Peavine, Jory, and Woodburn soils have pod and pore surfaces covered with films of oriented silicate clays that have been moved by soil water from the A horizon to the B horizon.

Astoria, Hembre, Klickitat, and other soils in the Coast Range do not show evidence of clay movement. They are young soils that formed on young landscapes and are high in amorphous material. The B horizon shows high porosity, low bulk, density, and less stickiness and plasticity than is common in many of the other soils.

Soils that formed in recent alluvium, such as those of the Cloquato and Chehalis series, are too young to show any evidence of clay movement or accumulation, but they have structural development. Cove soils have a high clay content inherited from the parent material, and they have a weak to moderate prismatic structure.

The clayey horizons in the Hazelair and Dayton (12) soils are remnants of older soils or parent materials. Because the topography is level, these horizons have caused pool drainage and the development of all A2 horizon in the Dayton soils. Hazelair soils have enough slope to allow lateral movement of water. They have moderately good to somewhat poor drainage and no discernible A2 horizon development.

Base-saturation levels. - The leaching of cations is common in all of the soils except the most recent ones along the major streams. The most extreme leaching has occurred in the Astoria, Hembre, Klickitat, and other Coast Range soils that have high permeability, good drainage, and are subject to heavy rainfall. There is some nutrient circulation by plants in these soils, as evidenced by the higher base saturation in the surface horizon (see Astoria data in table 10), but the entire profile is very low in base saturation and the soils are very strongly acid.

Jory, Nekia, Olyic, and other well-drained soils have base-saturation levels below 50 percent, and show a decreasing percentage with depth. Other well-drained soils on the hills and valley floor have base-saturation levels above 50 percent, and are either uniform or show a slight increase or decrease with depth. The pH levels generally increase in acidity with depth.

Somewhat poorly drained and poorly drained soils, such as Amity and Dayton soils, show significant increases of bases with depth. This is probably caused by the movement of bases in ground water into these soils from surrounding well-drained soils, and to slower and less frequent drainage of water through these soils.

Recent alluvial soils (see Cloquato data in table 10) have relatively uniform base levels because they are young and receive continuing additions of fresh alluvium during overflow.

Accumulation of free iron. The weathering of iron-bearing minerals to form ferric oxide and the accumulation of ferric oxides over a long period of time yield a large concentration of iron in a soil. Ferric oxide is insoluble in water, or very nearly so. The concentration of ferric oxides is responsible for the reddish color in "red hill" soils, such as Jory and Nekia, that are much redder than other soils in the Yamhill Area. Soils derived from parent material that is very high in iron-rich weatherable minerals, for example, Klickitat soils that formed over basalt, become reddish colored at an earlier age than soils derived from parent materials that are low in weatherable, iron materials, such as Astoria soils that formed over siltstone.

Concretions, or "shot," of iron oxide are common in the surface horizon of most of the soils in the Area.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 and later revised (3, 18). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965 (20). The current system is under continual study. Therefore, readers interested in developments of the current system should search the latest literature available (16). In table 9 the soil series of the Yamhill Area are placed in some categories of the current system.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available. The classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, the Entisols and Histosols, occur in many different kinds of climate. The four orders in the Yamhill Area are Alfisols, Inceptisols, Mollisols, and Ultisols.

The Alfisols are soils containing a clay-enriched B horizon, and that have either a dark-colored surface horizon that has intermediate base saturation, or that have a light-colored surface horizon that has high or intermediate base saturation. The Laurelwood and Willakenzie soils are Alfisols.

Inceptisols are soils that have one or more of the diagnostic horizons that are thought to form rather quickly and that do not represent significant illuviation, eluviation, or extreme weathering. Astoria and Hembre soils are typical of the Inceptisols.

The Mollisols are mineral soils that have a dark surface and show illuviation in places. They have a base saturation of more than 50 percent throughout the solum. Willamette and Chehalem soils are representative of the Mollisols.

The Ultisols are mineral soils that have distinct horizons. They contain a clay-enriched B horizon that has low base saturation. The base saturation decreases with increasing depth. Peavine and Melby soils are typical of the Ultisols.

SUBORDER. Each order is divided into suborders, primarily on the basis of those soil characteristics that seem to produce classes having the greatest genetic similarity. The suborders have a narrower climatic range than the orders. The criteria for suborders chiefly reflect the presence or absence of waterlogging or soil differences that result from the climate or vegetation.

GREAT GROUP. Soil suborders are divided into great groups on the basis of uniformity in kinds and sequence of major soil horizons and other features. The horizons used as a basis for distinguishing between great groups are those in which (1) clay, iron, or humus has accumulated; (2) a pan has formed that interferes with. growth

In the original manuscript, there was a table in this space.
All tables have been updated and are available as a separate document.

of roots, movement of water, or both; or (3) a thick, dark-colored surface horizon has developed. The other features commonly used are the self-mulching properties of clay, temperature of the soil, major difference in chemical composition (mainly the bases calcium, magnesium, sodium, and potassium), or the dark-red or dark-brown colors associated with soils formed in material weathered from basic rocks.

Names of the great groups consist of three or four syllables. They are made by adding a prefix to the name of the suborder. An example is Haplaquoll (Hapl, meaning usual, and aquoll, meaning soils seasonally saturated with water). The great group is not shown separately in table 9, because it is the last word in the name of the subgroup.

SUBGROUP. Great soil groups are, divided into subgroups. One of these represents the central, or typic, segment of the group. Other subgroups have properties of the group but have one or more properties of another great group, suborder, or order, and these are called intergrades. Also, subgroups may be established for soils having properties that intergrade outside the range of any other great group, suborder, or order. The names of subgroups are formed by placing one or more adjectives ahead of the, name of the great group. An example is Cumulic Humaquepts.

FAMILY. Families are established within a subgroup, primarily on the basis of properties that are important to the growth of plants or to the behavior of soils used for engineering. The main properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. The names of families consist of a series of adjectives that precede the name of a subgroup. The adjectives used are the class names for soil texture, mineralogy, and so on (see table 9). An example is the coarse-silty, mixed, mesic family of Cumulic Ultic Haploxerolls.

SERIES. The series consists of a group of soils that formed from a particular kind of parent material and have genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, structure, reaction, consistence, and mineralogical and chemical composition.

New soil series must be established and concepts of some established series must be revised in the course of the soil survey program across the country. A proposed new series has tentative status until review of the series concept at state, regional, and national levels of responsibility for soil classification results in a judgment that the new series should be established. Twenty-one of the soil series described in this publication had tentative status when the survey was sent to the printer. They are the Aloha, Briedwell, Chehalem, Cloquato, Dupee, Ead, Hazelair, Jory, Klickitat, Labish, Laurelwood, McBee, Melby, Nekia, Olyic, Panther, Peavine, Steiwer, Willakenzie,

Woodburn, and Yamhill series. The other series in this survey were established earlier.

Descriptions of soil series by subgroups

A discussion of the soil series in the Yamhill Area by subgroups is given in the following paragraphs.

Cumulic Humaquepts-The Labish soils are in this subgroup. They are poorly drained, clay soils that formed on lake beds. They are black mucky clay and clay soils with chromas of 1 or less and have base saturation of less than 60 percent in the upper four feet of depth. They are high in organic-matter content and they overlie peat at depths of 26 to 34 inches.

Typic Haplumbrepts-The Hembre and Klickitat soils are in this subgroup. They are well-drained soils that formed over basalt. Slopes are 3 to 90 percent. Average annual soil temperature is about 51° F. The soils have a dark A horizon that is between 10 and 20 inches thick, and they have a base saturation of less than 60 percent.

The Hembre soils are typical of this subgroup. Characteristically, they have a dark reddish-brown silt loam A horizon about 12 inches thick. The B2 horizon is dark reddish-brown and reddish-brown, friable silty clay loam about 18 inches thick. The B3 horizon is yellowish-red silty clay loam about 14 inches thick, and like the B2 horizon it is very strongly acid. The R horizon is basalt bedrock.

The Klickitat soils are similar to Hembre soils in some respects, but differ mainly in that the B2 horizon contains more than 50 percent coarse fragments.

Andic Haplumbrepts-The Astoria soils are in this subgroup. They are well-drained soils that formed on sedimentary rock. Slopes are 5 to 90 percent. Average annual soil temperature is about 51° F. These soils have a dark-colored A1 horizon about 16 inches thick. The A and B horizons have low bulk density and evidence of amorphous clays. The A horizon and particularly the B2 horizon have very low base saturation. Laboratory data for a typical Astoria soil are given in table 10.

Aquic Haplumbrepts.-Acid variants of the Hazelair series belong in this subgroup. They are moderately well drained soils underlain by siltstone. Average annual soil temperature is about 52° F. These soils have a dark-colored A1 horizon about 11 inches thick and base saturation of less than 50 percent. They are mottled by chromas of 2 to a depth of within 20 inches of the surface. The soils have a very fine textured control section. Depth to siltstone ranges from 30 to 40 inches.

Lithic Haplumbrepts.-The Kilchis soils are in this subgroup. They are excessively drained soils that are underlain by basalt at depths of 12 to 20 inches. Slopes are 60 to 90 percent. Average annual soil temperature is about 51° F.

These soils have a dark reddish-brown stony loam A1 horizon about 7 inches thick. The B2 and C horizons are very gravelly loams that contain more than 50 percent coarse fragments. They are 12 inches deep over basalt.

Pachic Haplumbrepts.-The Ead and Knappa soils are in this subgroup. They are well-drained, dark-colored soils. Their surface layer has a base saturation of less than 50 percent to depths of more than 20 inches. Average annual soil temperature is about 51° F.

The Knappa soils formed in old alluvium on low terraces. They have a very dark grayish-brown silty clay loam surface layer about 8 inches thick. The upper part of the B horizon is dark-brown silty clay loam about 13 inches thick. The lower part of the B horizon is dark yellowish-brown silty clay loam about 24 inches thick. Ead soils are similar except that the B horizon is light clay, and siltstone or shale is at depths of less than 40 inches.

Aquic Xerochrepts-The Aloha soils are in this subgroup. They are somewhat poorly drained soils that formed in old alluvium on terraces that have slopes of 0 to 3 percent. Average annual soil temperature is about 55° F. These soils are dry for 60 consecutive days or more in more than 7 out of 10 years in all parts of the soil between 4 and 12 inches. They have mottles with chromas of 2 or less to a depth of within 30 inches of the surface.

Aloha soils have a dark brown A1 horizon about 7 inches thick. Immediately below this horizon the soil is dark brown when moist and has a value of 4; when dry, it is light yellowish brown and has a value of 6.

Typic Dystrochrepts.-The Melby soils are in this subgroup. They are well-drained soils that formed over sedimentary rock. Slopes are 3 to 60 percent. Average annual soil temperature is about 51° F.

These soils have moist chromas of 2 in the upper part of the A horizon and 4 in the lower part, The A horizon is silt loam about 11 inches thick, and the B horizon is silty clay loam and silty clay about 33 inches thick. Depth to sedimentary, rock is 40 to 60 inches.

Andic Dystrochrepts-The Steiwer silt loams, acid variant, are in this subgroup. They are well-drained soils 20 to 40 inches deep over sedimentary rock. Slopes are 3 to 20 percent. Average annual soil temperature is about 51° F.

The A and B horizons have low bulk density, evidence of amorphous clays, and presumed low base saturation. The A horizon is dark brown and has moist values and chromas of 3; it is about 8 inches thick.

Aquic Dystrochrepts.-Grande Ronde soils are in this subgroup. They are somewhat poorly drained and nearly level. These soils formed in old alluvium on terraces in small valleys. Average annual soil temperature is about 51° F.

The A horizon has color values of 6 when dry and 4 when moist. The B2 horizon, at depths of 11 to 21 inches, has gray coatings of clean silt and fine sand grains on ped faces. There are distinct or prominent mottles in the A, B, and IIC horizons.

Typic Haplohumults.-The Olyic and Peavine soils are in this subgroup. These are well-drained soils. Slopes are 3 to 90 percent. Annual precipitation is 55 to 70 inches. Average annual soil temperature is about 51° to 53° F. These soils are never dry in the moisture control section for as much as 60 consecutive days in more than 7 out of 10 years. These soils have base saturation of less than 35 percent below a depth of about 15 inches. (See laboratory data for a typical Peavine soil in table 10.) The soils have high organic-matter content in the A horizon and in the upper argillic horizon.

Peavine soils are representative of this subgroup. They have a very dark brown and dark-brown silty clay loam A horizon about 10 inches thick. The B horizon, a horizon

of clay accumulation, is dark reddish-brown and yellowish-red silty clay about 26 inches thick. Depth to siltstone or shale is 20 to 40 inches.

Olyic soils are somewhat similar, but differ mainly in that they have silty clay loam B2t horizons containing shale fragments and are underlain by basalt at a depth of more than 40 inches.

Xeric Haplohumults-The Jory and Nekia soils are in this subgroup. They are well-drained soils that formed in colluvium from tuff and basalt. They are on foothills and have slopes of 2 to 50 percent. Average annual soil temperature is about 54° F. Organic-matter content is high in the upper 40 inches of the soil. In most years Jory soils are dry between depths of 4 and 12 inches for more than 60 consecutive days following the summer solstice.

The Jory soils are characteristic of this subgroup. They have a thick, dark reddish-brown clay loam and silty clay loam Al horizon. The B2t horizon is dark reddish-brown clay about 35 inches thick that has a base saturation of less than 35 percent.

Nekia soils are essentially similar to Jory soils except that they are 20 to 40 inches deep over bedrock, whereas Jory soils are more than 40 inches deep over bedrock.

Argiaquic Xeric Argialbolls.-The Amity soils are in this subgroup. They are somewhat poorly drained soils that formed in mixed alluvial silts. They are on broad valley terraces and have slopes of 0 to 2 percent. Amity soils have a very dark grayish-brown Al horizon that has high base saturation. Underlying the Al horizon is a mottled, gray when moist, A2 horizon about 4 inches thick. The increase in clay content from the A2 horizon to the B21t horizon is less than 20 percent. In most years the Amity soils are dry between depths of 4 and 12 inches for more than 60 consecutive days within the 3-month period following the summer solstice.

Typic Haplaquolls.-The Panther soils are in this subgroup. They are poorly drained and are underlain by siltstone at a depth of more than 40 inches. Slopes are 4 to 20 percent. Average annual soil temperature is about 54° F. These soils have a black to very dark brown Al horizon that has distinct mottling in the lower part. Base saturation is 55 percent or more in the A, B, and C horizons. Organic-matter content exceeds 1 percent in the upper 14 inches. (See laboratory data for a typical Panther soil in table 10.) The clay B2 horizon, beginning at a depth of 14 inches, is mottled dark grayish brown and olive brown when moist and light brownish gray when dry.

Cumulic Haplaquolls.-The Chehalem soils are in this subgroup. They are somewhat poorly drained soils that formed in alluvium. They are on alluvial fans. Slopes are 3 to 12 percent. Average annual soil temperature is about 55° F. Chehalem soils have a very dark brown A horizon about 23 inches thick and high base saturation. The upper part of the B2 horizon is distinctly mottled very dark grayish brown and is about 13 inches thick. The organic-matter content is high and decreases irregularly as depth increases in the upper 50 inches.

Fluvaquentic Haplaquolls.-The Wapato soils are in this subgroup. They are poorly drained soils that formed in alluvium on flood plains. Average annual soil temperature is about 55° F.

These soils have a very dark grayish-brown A horizon that has distinct mottles and high base saturation. The B2 horizon is distinctly mottled dark grayish brown. Organic-matter content decreases irregularly as depth increases.

Vertic Haplaquolls.-The Cove soils are in this subgroup. They are poorly drained soils that formed in recent alluvium on bottom lands and outwash fans. They are on level, slightly concave or gently sloping topography. Average annual soil temperature is about 55° F. These soils have low chromas and distinct or prominent mottling within depths of 20 inches of the surface. They have high base saturation. The B2 horizon, about 33 inches thick, has a clay texture. It shrinks and cracks when dry.

Aquultic Argixerolls.-The Woodburn soils are in this subgroup. They are moderately well drained soils that formed in silty alluvium of mixed mineralogy. They are on broad valley terraces. Slopes are 0 to 20 percent. Average annual soil temperature is about 55° F. In most years these soils are dry between depths of 4 and 12 inches for more than 60 consecutive days within 3 months following the summer solstice.

The Woodburn soils have a very dark brown or very dark grayish-brown A horizon. The B2t horizon is dark yellowish brown and dark grayish brown and has dark-gray coatings at depths of less than 30 inches. The base saturation in the A and B2t horizons is less than 75 percent.

Pachic Ultic Argixerolls-The Willamette soils are in this subgroup. They are well-drained soils that formed in silty material on terraces. Average annual soil temperature is about 55° F. In most years these soils are dry between depths of 4 and 12 inches for more than 60 consecutive days within the 3 month period following the summer solstice.

Characteristically, these soils are dark brown. Organic-matter content is more than 1 percent throughout the upper 24 inches of the profile. Base saturation in the upper 30 inches of the profile is between 50 and 75 percent. The B2t and B3t horizons of clay accumulation are dark-brown silty clay loam or heavy silt loam.

Aquultic Haploxerolls.-The Hazelair soils are in this subgroup. They are somewhat poorly drained soils that formed on sedimentary rock. They are on low hills. Slopes are 2 to 20 percent. Average annual soil temperature is about 55° F. In most years these soils are dry between depths of 4 and 12 inches for more than 60 consecutive days within the 3-month period following the summer solstice.

The Hazelair soils have a dark-brown and dark yellowish-brown Al horizon. There are distinct mottles between depth of 11 and 24 inches. There is no horizon of clay accumulation. Depth to the unconformable clay IIC horizon is less than 24 inches. The base saturation in the upper 30 inches of the soil profile is more than 50 percent and less than 75 percent.

Cumulic Ultic Haploxerolls.-The Chehalis, Cloquato, and McBee soils are in this subgroup. The McBee series consists of moderately well drained soils that formed in alluvium. Average annual soil temperature is about 55° F. All of these soils are dry in most years between depths of 4 and 12 inches for more than 60 days within the 3-month period following the summer solstice.

The Cloquato soils are representative of this subgroup. Texture is dominantly silt loam to a depth of 5 feet. The

A horizon is dark brown. The B horizon is dark brown to at least 20 inches depth and dark yellowish brown below this depth. The organic-matter content is high and decreases irregularly as depth increases in the upper 50 inches. (Laboratory data for a typical Cloquato soil are given in table 10.) Typically the base saturation for this and other soils of this subgroup is more than 50 percent but less than 75 percent in the upper 30 inches.

The Chehalis soils are silty clay loam to a depth of 5 feet or more; otherwise they are similar to Cloquato soils. The McBee soils are similar to the Chehalis soils, except that the B21 horizon is faintly mottled and the B22 and C horizons, below a depth of 35 inches, are distinctly mottled.

Fluventic Haploxerolls.-The Newberg soils are in this subgroup. They are somewhat excessively drained soils that formed in alluvium on flood plains. They are subject to flooding. Average annual soil temperature is about 55° F. In most years the Newberg soils are dry between depths of 8 and 24 inches for more than 60 consecutive days within the 3-month period following the summer solstice.

The A horizon is very dark grayish-brown fine sandy loam about 8 inches thick. It has high base saturation. The AC horizon, between depths of 8 and 18 inches, is dark-brown sandy loam. The C1 horizon, between depths of 18 and 28 inches, is very dark grayish-brown coarse sandy loam, and the C2 horizon, between depths of 28 to 42 inches, is dark-brown loamy fine sand. Organic-matter content decreases irregularly as depth increases.

Pachic Ultic Haploxerolls.-The Carlton and Yamhill soils are in this subgroup. Carlton soils are moderately well drained soils that formed in mixed alluvium and colluvium on low terraces and foot slopes. Slopes are 0 to 20 percent. Yamhill soils are well-drained soils that formed over basalt on low hills. Slopes are 2 to 50 percent. Average annual soil temperature is about 54° F. In most years these soils are dry between depths of 4 and 12 inches for more than 60 consecutive days within the 3-month period following the summer solstice. These soils are dark colored and have an organic-matter content of at least 1 percent in the upper 20 inches of the profile. Base saturation in the upper 30 inches of the profile is more than 50 percent but less than 75 percent.

Carlton soils have a very dark grayish-brown, silt loam A horizon that is about 12 inches thick. The dark-brown B2 horizon, extending to a depth of about 42 inches, is faintly mottled silty clay loam. The brown IIB3 horizon, between depths of 42 and 60 inches, is faintly mottled silty clay. Yamhill soils are similar but differ mainly in that the B2 horizon is dark reddish-brown silty clay, and basalt rock is at depths of 20 to 40 inches.

Ultic Haploxerolls.-The Briedwell and Steiwer soils are in this subgroup. They are well-drained soils that formed over alluvium and colluvium. Slopes are 0 to 50 percent. Average annual soil temperature is about 55° F. In most years these soils are dry in the moisture control section for more than 60 consecutive days within the 3-month period following the summer solstice. Base saturation in the upper 30 inches of the profile is more than 50 percent but less than 75 percent. (Laboratory data for a typical Steiwer soil are given in table 10.)

The Steiwer soils have a dark-brown silty clay loam A1 horizon, about 6 inches thick, which is high in organic-matter content. The B1 and B21 horizons, between depths of 6 and 19 inches, are similar to the A1 horizon but are clay loam in texture. The B22 horizon is dark yellowish-brown clay loam abruptly overlying fractured shale and sandstone at a depth of about 27 inches. Briedwell soils are similar except they overlie an unconformable very gravelly clay loam IIC horizon below a depth of 25 inches.

Typic Albaqualfs.-The Dayton soils are in this subgroup. They are poorly drained soils that formed in alluvium. They are on broad valley terraces in shallow depressions and drainageways. Slopes are 0 to 2 percent.

The Dayton soils have an Ap horizon of silt loam that is grayish brown when moist, is gray when dry, and has a base saturation of between 35 and 50 percent. The A2 horizon is grayish-brown silt loam when moist and light gray when dry. It has many prominent mottles. It has an abrupt textural boundary to the clay IIB2t horizon. The IIIB3t horizon, below a depth of 28 inches, is silty clay loam that is mottled grayish brown when moist.

Aquultic Haploxeralfs.-The Dupee soils are in this subgroup. They are somewhat poorly drained soils. They are on uplands underlain by sedimentary rock. Slopes are 3 to 20 percent. In all parts of the soil within the 1 to 12 inch section of the profile these soils are dry most years for 60 consecutive days or more within the 3-month period following the summer solstice.

The Dupee soils have an Ap horizon that is dark brown when moist and brown when dry. (See laboratory data in table 10.) The loam B1 horizon is dark yellowish brown when moist. The B2t horizon is mottled heavy clay loam in the upper part and clay in the lower part. The upper 30 inches of this soil has base saturatiou of less than 75 percent.

Ultic Haploxeralfs.-The Laurelwood and Willakenzie soils are in this subgroup. They are well-drained soils. Slopes are 2 to 60 percent. Average annual soil temperature is 53° to 55° F. The B2t horizons have base saturation of more than 35 percent, but less than 75 percent. (See laboratory data for Willakenzie soils in table 10.) In most years these soils are dry between depths of 4 and 12 inches for 60 consecutive days or more within the 3-month period following the summer solstice. The average summer and average winter soil temperatures differ by more than 9° F.

The Willakeuzie soils have an A horizon 4 inches thick that is silty clay loam and is dark brown when moist. The B2t horizon is dark-brown silty clay loam. The IIR horizon is fractured siltstone and is at a depth of about 36 inches. The Laurelwood soils are similar; they differ mainly in being underlain by unconformable silty clay.

Laboratory Data

This section includes laboratory data on seven selected soil profiles. Table 10 summarizes this data.

The determinations are described in Soil Survey Investigations Report No. 1 (*21*).

All samples were collected from pits. After air drying, the samples were crushed and passed through a 2-millimeter round-hole screen. The fraction greater than 2 millimeters in diameter is reported as weight percentage of the total sample (*19*). Analysis was made on soil material

less than 2 millimeters in diameter. Results are reported on an ovendry basis. Empty columns indicate that the determinations were not made.

The particle-size distribution analysis was made by the pipette method (organic matter and soluble salts removed) with dispersion in sodium hexametaphosphate and mechanical shaking (8, 9). Reaction determinations were made by glass electrodes using soil-water and soil-salt ratios indicated (13, 15). Organic carbon was determined by wet combustion by use of the Walkley-Black method (6). Total nitrogen was obtained by the Kjeldahl method (2).

Extractable manganese was reduced and extracted by sodium dithionite, and manganese was determined colorimetrically.

Extractable iron was reduced and extracted by sodium dithionite and the extract was titrated with potassium dichromate (7).

Extractable cations were leached with 1 N NH4OAc. Extractable sodium and potassium were determined by flame photometry; calcium by permanganate titration; and magnesium gravimetrically as pyrophosphate. Extractable acidity was determined by the triethanolamine-barium chloride method. Cation-exchange capacity (CEC) is the sum of extractable cations and extractable acidity; base saturation is the sum of extractable calcium, magnesium, sodium, and potassium as percentage of the cation-exchange capacity.

The amount of water and the bulk density at 1/3-bar tension were determined on plastic-coated clods in a porous-plate pressure cooker (5). Water held at 15-bar tension was measured on disturbed samples in a pressure membrane apparatus. Linear extensibility (LE) is the change in the diameter of a soil clod between the moisture content under 1/3-bar tension and ovendryness.

General Nature of the Area

This section is primarily for those who are not familiar with the Yamhill Area. It discusses physiography, relief, and drainage; climate; settlement and development; transportation and industries; and farming. Unless otherwise stated, statistics about farming are from records of the U. S. Bureau of the Census.

Physiography, Relief, and Drainage

The Yamhill Area is in the Middle Willamette, Lower Willamette, and North Coast River basins. It extends from the west slopes of the Coast Range to the Willamette River. More than 95 percent of the Area drains eastward through the forks of the Yamhill River and Chehalem Creek, and into the Willamette River.

The lowest point within the Area is on the bottom land east of Newberg where the Willamette River enters Clackamas County. The valley floor rises gradually from 150 feet elevation to more than 300 feet in the southwestern end of the Area. Along the western side, the Coast Range reaches an elevation of 3,422 feet on Trask Mountain.

The survey area has two major physiographic areas: a hilly and mountainous area in the western and northern part, and a smooth valley area in the southeastern part that has some low hills.

The hills and mountains, which occupy about two-thirds of the hilly and mountainous area, drain into three river basins. The perennial Nestucca and Trask Rivers drain the western slopes of the Coast Range into the North Coast River Basin. The Gaston area and northeastern slopes of Chehalem Mountains drain into the Lower Willamette River Basin through the perennial Tualatin River and numerous intermittent small streams. The remainder of this hilly and mountainous area drains through intermittent and perennial streams into the South Yamhill and North Yamhill Rivers and Chehalem Creek, and into the Middle Willamette River Basin. Slopes are steep to precipitous in the northwestern part of the Coast and they become more rounded and moderately steep toward the eastern and southern foot slopes.

The valley area is divided into four parts: terraces alluvial fans, flood plains, and low hills that rise out of the valley floor.

The terraces are made up of broad, nearly level alluvial and lacustrine material that has been partly dissected by stream channels ranging in depth from 10 feet to more than 50 feet.

The alluvial fans are gently to strongly sloping and consist of material that has been deposited over terraces and flood plains at the months of side draws and canyons. Some rock arid soil deposition still occurs during periods of heavy rain on unprotected watersheds.

The flood plains lie along the South Yamhill, North Yamhill, and Willamette Rivers. Under natural conditions, soils on these flood plains are subject to occasional to frequent flooding during winter. There are many meandering sloughs, rivet-ways, and bypass channels that carry much of the floodwater. Deposition of sand and silt is common during the overwash periods. Low dikes give some protection to single farms. Flood-control structures on the upper Willamette River and its tributaries have reduced the flood hazard along the river.

The low rolling hills are remnants of sandstone and siltstone formations and basalt flows that were eroded and truncated by streams. Alluvial and lacustrine material more than 200 feet thick in some places has been deposited in the old valleys to form the present valley floor that surrounds these gently to steeply sloping hills.

Climate

The Yamhill Area, in common with all of western Oregon, has a modified marine climate. Rainfall along the upper slopes of the Coast Range of Oregon and Washington is the heaviest in the contiguous United States. Although a considerable amount of rainfall is carried to the east side of these mountains, the amount decreases sharply on the lower slopes and on the valley floors.

The survey area has three climatic zones, distinguished mainly by elevation: the valley floor, the foothills of the Coast Range, and the Coast Range. Tables 11 and 12 show the temperature and precipitation characteristics in each of these zones.

'By GILBERT L. STERNES, climatologist for Oregon, National Weather Service, U.S. Department of Commerce.

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All tables have been updated and are available as a separate document.

Temperature.-There are few extremes of temperature in western Oregon either in winter or summer. On the valley floor of the Yamhill Area, temperatures of 90° F. or more occur on an average of 15 to 20 days a year; temperatures below 32° F. occur on an average of 60 to 70 days a year. In the foothills of the Coast Range there are 10 to 15 days of 90° F. or more, and 65 to 75 days of 32° F. or less. On the upper slopes of the Coast Range there are 5 to 10 days of 90° F. or more, and 75 to 85 days of 32° F. or less. Temperatures of 100° F. or more occur only about every other year, and those of 0° F. or lower can be expected about 1 year in 20-less often than this on the valley floor, somewhat more frequently on the higher slopes of the Coast Range. Table 12 shows the probability of freezing temperatures in spring and fall.

Precipitation.-In the Yamhill Area rain falls mostly in winter. Table 11 gives data on precipitation. Approximately 70 percent of the annual total falls in the period November through March and only 5 to 10 percent in the period June to August. In the main agricultural areas, nearly all precipitation in winter falls as rain. Only on the higher slopes of the Coast Range can significant amounts of snow normally be expected. On the valley floor the total snowfall for the entire winter often does not exceed 5 or 6 inches; only an inch or two of snow accumulates and it usually melts within the day. On rare occasions 8 to 12 inches of snow accumulates at the lower elevations, but even these heaviest falls seldom remain on the ground longer than a few days. Measurable precipitation (0.01 inch or more) occurs on an average of 150 to 180 days a year and on the greater number of days at the higher elevations. In winter precipitation is the result of storms moving in from the Pacific Ocean. In summer precipitation is most often the result of an occasional thunderstorm. As late as the middle of June there is still about 1 chance in 3 of rain or rain showers on any one day. Usually these early summer showers are light, but they do interfere with haying and harvesting of grass seed, and on occasion they cause cracking of cherry and plum crops. The heavy winter storms occasionally produce major flooding of rivers in the survey area, but multiple-purpose dams in much of the headwater area of the Willamette River have largely eliminated this problem along the mainstream. Bottom land is inundated each year.

Relative humidity.-Because marine air normally moves across the survey area, humidity is relatively high most of the year. The exceptions are periods of either extremely low winter or high summer temperatures that mark the invasion of very dry continental air masses. In summer, under these conditions, humidity as low as 10 or 15 percent is not unusual during the warmest part of the day. Because the air is dry during periods of extreme temperatures, discomfort is greatly reduced. Most significant, from the standpoint of farming, is the fact that nighttime relative humidity, particularly a few hours before dawn, is nearly 100 percent throughout the year. Humidity at 4:00 a.m. in July, the driest month, averages more than 85 percent. Heavy dew, which may persist for several hours, can be expected any time of the year. Humidity is not measured regularly in the Yamhill Area. A combined average of records obtained at the Salem and Portland International Airports is presented in table 13, and is fairly representative of the survey area.

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Cloudiness and sunshine.-Frequent storms that move in from the Pacific Ocean and cooling of the marine air as it is lifted over the Coast Range combine to produce considerable cloudiness from mid-October to mid-March. Even during this period, however, bright sunny periods of several days duration can be expected quite a few times each year. Table 14 summarizes cloudiness and sunshine on a monthly and annual basis for the Yamhill Area.

Storms.-An average of 6 to 8 thunderstorms occur on the valley floor every year. At higher elevations in the Coast Range roughly twice this number occur. The storms generally are fairly local in extent, and the accompanying lightning is not a serious hazard. The lightning often, however, causes forest fires that annually destroy several thousands of acres of timber. Otherwise property damage caused by lightning is usually insignificant.

Hail.-Late in winter and early in spring precipitation in the form of small hailstones is likely to occur. Hailstones that are large enough to cause serious damage to property or crops are quite rare, probably averaging less than one occurrence a year throughout the area. Damage, when it does occur, generally is confined to very small areas, seldom covering as much as 100 acres. There is no record of tornado occurrence in the Yamhill Area.

Settlement and Development

The Yamhill Area was known to early-nineteenth century Hudson's Bay fur trappers. The origin and meaning of the name Yamhill is not definitely known, but best evidence indicates that it was the early settlers' name for the Yam-il Indians who were of the Kalapooian family.

In July 1843 at Champoeg, across the Willamette River from Newberg, the first provisional government divided the Oregon Territory into four legislative districts, one of which was Yamhill. Yamhill occupies the southwestern part of the territory, the northern boundary of which was a line from the Pacific Ocean east to the Yamhill River, and the eastern boundary was a north-south line along the Willamette River and on to the California border. Through the years, now counties were created from the Yamhill district.

Fur trappers were followed by settlers who grazed cattle on the level grasslands in the Yamhill and Willamette Valleys. During the 1840's and 1850's, hundreds of families came over the Oregon Trail and took up land claims. As the population increased, spring wheat became the major farm enterprise, and the cattle were moved into the hills to graze. Steamboats carried farm products down the Yamhill and Willamette Rivers to Portland.

When the Southern Pacific Railroad came to Newberg and McMinnville in 1887, farmers began to raise fruits, vegetables, and berries. The railroads were extended into the Coast Range, and timber became a major enterprise.

In 1900 Yamhill County had a population of 13,000. McMinnville and Newberg each had about 1,000 people

During the next 20 years, county population grew by more than 50 percent, and McMinnville and Newberg doubled in size. County population increased from 32,478 in 1960 to 37,000 in 1964. About 52 percent of the county's residents live in incorporated areas.

Yamhill County has two State parks, eleven county parks, and several U. S. National Forest camps and Boy Scout camps. The Willamette River is used for boating and water skiing. Public and private golf courses are available.

Transportation and Industries

The Yamhill Area is served by a branch line of a major railroad for freight and express service. Buslines offer passenger service.

Nearly all farms are served by paved or graveled county roads that join the Federal and State Highways. Graded roads extend to most parts of the mountainous areas, but many of them are not maintained throughout the year. Some of these roads are privately owned logging roads. Numerous spur and access roads branch off the main roads. Many of these have been abandoned, or are not maintained.

Several truck lines provide freight service to the Area and air service by airplane and helicopter is available at the McMinnville airport.

Most of the industries in the Yamhill Area are directly related to the production or processing of agricultural and woodland products. Canneries, dryers, and food freezing plants are located in McMinnville, Carlton, Dayton, Dundee, and Newberg. Sawmills and plywood plants are located throughout the survey area. There are 15 in the Sheridan-Willamina area alone. A papermill is located in Newberg. McMinnville has two mills, processing plants, and several other kinds of industries, including a mobile home factory, electronics corporation, and fabric factory.

Farming

The Yamhill Area produces a wide variety of crops such as grains, berries, orchard fruit, seed crops, pasture plants, hay, special crops, and woodland products.

The Area has shown a steady increase in the dollar value of farm products sold. Yamhill County ranks eighth in the counties of Oregon for the sale of these products. Cattle, chickens, turkeys, eggs, vegetables, special crops, and forest products have shown the greatest gain in productivity.

The land in farms and the number of farms has decreased slightly and the average size of farms has increased in acreage over the period 1954 to 1964. There is a trend toward an increase in the number of farms that are more than 200 acres in size, and a decrease in the number of farms less than 20 acres. The number of farms that have irrigation has increased since 1954.

The 1964 census indicates that there were 2,056 farms, farm acreage totaled 254,970 acres, and the average-size farm was 124 acres.

Following are the acreages of the principal crops in the survey area in 1964.

Annual ryegrass	5,326
Alfalfa and alfalfa mixtures	1,923
Barley	17,703
Beans, pole and bush	2, 396
Bentgrass seed	2,028
Crimson clover seed	5,748
Grass, clover, timothy hay	8,947 2,
Hairy vetch seed	260
Oats	7,890
Raspberries	402
Small grain hay	694
Strawberries	904
Sweet corn	3,802
Tame blackberries	108 975
Vetch and pea hay	99, 350
Walnuts	
Wheat, fall and spring	20,032
Wild and other tame hay	2,596

There were 269,706 filbert trees, 272,082 plum trees, and 103,424 cherry trees in the Area in 1964.

Poultry and poultry products are the most important livestock enterprise in the Yamhill Area. Dairy cattle and dairy products are next in importance. Beef and sheep are also important. Income from livestock products amounts to about 45 percent of the total gross agricultural income.

Literature Cited

(1) AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS.
1961. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8, 2 v., illus. Washington, D.C.

(2) ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.
1955. OFFICIAL METHODS OF ANALYSIS. Ed. 6, 932 pp., illus. Washington, D.C.

(3) BALDWIN, MARK, KELLOGG, CHARLES E., and THORP, JAMES.
1938. SOIL CLASSIFICATION. Soils and Men, U.S. Dept. Agr. Ybk., pp. 979-1001, illus.

(4) BALSTER, C. A., and PARSONS, R. B.
1968. GEOMORPHOLOGY AND SOILS, WILLAMETTE VALLEY, OREGON. Spec. Report 265, Oreg. Agr. Expt. Sta. in coop. with U.S. Dept. Agr., Soil Conserv. Serv., 31 pp., illus.

(5) BRASHER, B. R., FRANZMEIER, D. P., VALASSIS, V., and DAVIDSON, S. E.
1966. USE OF SARAN RESIN TO COAT NATURAL CLODS FOP BULK-DENSITY AND WATER-RETENTION MEASUREMENTS. Soil Sci. 101: 108.

(6) JACKSON, M. L.
1958. SOIL CHEMICAL ANALYSIS. 498 pp., illus. Englewood Cliffs, N.J.

(7) KILMER, V. J.
1960. THE ESTIMATION OF FREE IRON OXIDES IN SOILS. Soil Sci. Sec. Amer. Proc. 24: 420-421.

(8) - 'and ALEXANDER, L. T.
1949. METHODS OF MAKING MECHANICAL ANALYSES OF SOILS. Soil Sci. 68: 15-24.

(9) - and MULLINS, J. F.
1954. IMPROVED STIRRING AND PIPETTING APPARATUS FOR MECHANICAL ANALYSIS OF SOILS. Soil Sci. 77: 437-441.

(10) MCCARDLE, RICHARD E., and MEYER, WALTER H.
1930. THE YIELD OF DOUGLAS-FIR IN THE PACIFIC NORTHWEST. U.S. Dept. Agr. Tech. Bul. 201, G4 pp., illus.

(11) MATCALT, MELVIN E., and HAZARD, JOHN W.
1964. FOREST STATISTICS FOR NORTHWEST OREGON

(13) PEECH, MICHAEL, ALEXANDER, L. T., and others.
1947. METHODS OF SOIL ANALYSIS FOR SOIL-FERTILITY INVESTIGATIONS. U.S. Dept. Agr. Circular 757, 25 PP.
(14) PORT LAND CEMENT ASSOCIATION.
1962. PCA SOIL PRIMER. 52 pp., illus. Chicago, 111.
(15) RICHARDS, L. A.
19~54. DIAGNOSIS AND IMPROVEMENT OF SALINE AND ALKALI SOILS. U.S. Dept. Agr. Handbook 60. 100 pp., illus.
(16) SIMONSON, Roy W.
1962. SOIL CLASSIFICATION IN THEUNITED STATES. Sci. 137: 1027-1034.
(17) THEISEN, A. A., and KNOX, E. G.
1959. DISTRIBUTION AND CHARACTERISTICS OF LOESSIAL *Soil][,* PARENT MATERIAL IN NORTHWESTERN OREGON. Soil Sci. Soc. Am. Proc., 23: 385-388.
(18) THORP, JAMES. and SMITH. Guy D.
1949. HIGHER CATEGORIES OF SOIL CLASSIFICATION: ORDER. SUBORDER. AND GREAT SOIL GROUPS. Soil Sci. 67: 117-120, illus.
(19) UNITED STATES DFPARTMENT of AGRICULTURE.
1951. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handbook 18, 503 pp., illus.
(20)
1960. SOIL CLASSIFICATION. A COMPREHENSIVE SYSTEM, 7TH APPROXIMATION. 26.5 pp., illus. [Supplements issued in March 1967 and in September 19681
(21)
1967. *SOIL SJTMVI~N'* LABORATORY METHODS AND PROCEDURES FOR COLLECTING SOIL SAMPLES. Soil Survey Invest. Report No. 1, 50 pp., illus.
(22) UNITED STATES DEPARTMENT OF DEFENSE.
1968. UNIFIED SOIL CLASSIFICATION SYSTEM FOR ROADS, AIRFIELDS, EMBANKMENTS, AND FOUNDATIONS. MIL-STD-61913, 30 pp., illus.
(23) UNITED STATES DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE.
1967. MANUAL OF SEPTIC-TANK PRACTICE. Pub. Health Serv. Publication No. 526, 92 pp., illus.

Glossary

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Clay. As a soil separate, the mineral soil particles, less than 0.00-9 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are-

Friable.-When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.-When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.-When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.-When wet, adheres to other material and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.-When dry, moderately resistant to pressure: can be broken with difficulty between thumb and forefinger.

Soft.-When dry, breaks into powder or individual grains under very slight pressure.

Cemented.-Hard and brittle; little affected by moistening.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have low available water capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slow permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat *poorly drained soils* are wet for significant periods but not all the time, and in Podzolic soils commonly have mottlings below 6 to 16 inches, in the lower part of the A horizon, and in the B and C horizons.

Poorly *drained soils* are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.-The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.-The mineral horizon at the surface or just below an 0 horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.-The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused by (1) accumulation of clay, sesquioxides, humus, or some combination of these; (2) prismatic or blocky structure; (3) redder or stronger colors than the A horizon; or (4) some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.-The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.-Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Morphology, soil**.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineralogical, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

Mottling, soil**.** Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance-few, common, and many; size-fine, medium, and coarse; and *contrast-faint, distinct, and* prom*inent. The* size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; medium, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and coarse, more than 15 millimeters (about 0.6 inch) In diameter along the greatest dimension.

Nutrient, plant. Any element taken in by a plant, essential to its growth and used by it in elaboration of its food and tissue. Essential nutrients include nitrogen, phosphorus, calcium, potassium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and other elements, derived mainly from the soil; and

carbon, hydrogen, and oxygen, derived largely from the air and water.

Open drains. Ditches constructed for the purpose of removing surplus water from wetland; may also include cross-slope ditches on sloping soils to intercept surface runoff from adjacent areas.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degree of acidity or alkalinity are expressed thus:

pH		*pH*	
Extremely acid---------	Below 4.5		
Very strongly acid-	4.5 to 5.0		
Strongly acid -----	5.1 to 5.5	Mildly alkaline ------	7.4 to
Medium acid -----	5.6 to 6.0	Moderately alkaline-	7.8
Slightly acid ----------	6.1 to 6.5	Strongly alkaline---	8.5 to 0.0
		Very strongly alka	
		Tine ----------	9.1 and higher

Runoff. The rate at which water flows over the surface of a soil. The amount and rapidity of runoff is closely related to slope and is also affected by factors such as texture, structure, and porosity of the surface soil; the vegetative covering; and the prevailing climate. Relative degrees of runoff are as follows:

Very slow.-Surface water flows away so slowly that free water lies on the surface for long periods or enters immediately into the soil. Very little of the water is removed by runoff

Slow.-Surface water flows away so slowly that free water: covers the soil for significant periods or enters the soil so rapidly that only a small amount is removed as runoff. -Normally, there is little or no erosion hazard.

Medium-Surface water flows away at such a rate that a moderate proportion of the water enters the soil profile and free water lies on the surface for only short periods. The loss of water over the surface does not reduce seriously the supply available for plant growth. This commonly is considered good external drainage. The erosion hazard may be slight to moderate if soils of this class are cultivated.

Rapid.-A large proportion of the precipitation moves rapidly over the surface, and a small part moves through the soil profile. The erosion hazard commonly is moderate to high.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Siltstone. A very fine grained consolidated elastic rock that consists mainly of silt particles.

Slope wash. Soil and rock material that is being moved or has been moved downslope mainly through the action of gravity and of runoff water that is not concentrated in channels.

Slump. Downward slipping of a mass of rock or soil, moving as a unit, usually with backward rotation on a more or less horizontal axis parallel to the cliff or slope from which it descends.

Soil depth. The thickness of soil over a specified layer, generally one that does not permit the growth of roots. Classes used in this survey are:

Inches		*InchC8*	
Shallow ----------	10 to 20	Deep ----------	40 to 60
Moderately shallow-	20 to 40	Very deep -------	60 or more

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter) ; *coarse sand (1.0* to 0.5 millimeter) ; medium *sand* (0.5 to 0.25 millimeter) ; fine *sand* (0.25 to 0.10 millimeter) ; very *fine sand (0.10* to 0.05 millimeter) ; silt (0.05 to 0.002 millimeter) ; and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter) ; II (0.2 to 0.02 millimeter) ; III (0.02 to 0.002 millimeter) ; IV (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are, active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are-platy (laminated), prismatic (vertical axis of aggregates longer than horizonal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. *Structureless soils* are (1) single grain (each grain by itself, as in dune sand) or (2) massive (the particles adhering together without any regular cleavage, as in many claypans and hardpans)

Subsoil. Technically, the B horizon, roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms. as contrasted to flood plains. and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy* sand. *sandy* loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, *sandy clay,* silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very **fine."**

Variant, soil. A soil whose properties are believed sufficiently different from those of other known soils to justify a new series name but whose geographic area is so limited that creation of a new series is not believed to be justified.